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BIRDS OF NEW GUINEA.

BY GEO. S. MEAD.

(Continued from Vol. XXVIII, p. 920)

The Magnificent bird of paradise—*Diphyllodes magnifica* or *speciosa*, is as appropriately named as any of the *Paradisea*, since the qualifying adjectives are scarcely more than mere epithets, with nothing specially discriptive or distinctive about them. In the Magnificent we find an adornment not unlike that which beautifies the Superb, viz. a mantle or fringe of bright yellow feathers over an inch long, rising from the back of the neck. The bird is still further characterized by the long filaments noted in the Red and other members of the family. These feathers in the Magnificent curve into a double circle, differing, therefore, in shape from those of his cousins. A darker yellow than the mantle appears on the body above; this colour of course lights up or deepens with the play of light upon it, just as does also "the rich green flushed with purple" of the parts underneath, so that when the full, expanded plumage is displayed, the radiant little creature will be seen to possess every claim to his title. The under or secondary mantle, whence the generic name, rich and warm in color, sets off still more the novel charms of the bird. In size he is one of the smallest of his race, being but little larger than the King.

Another bird of paradise is not inaptly called the Incomparable, for it is wondrously attired, yet this designation too might as fittingly to bestowed upon almost any species where each is conspicuous for some particular charm. But in one respect at least this paragon (*Paradisea gularis*) presents a decided contrast to other *genera*—in the structure or appearance of the tail. In place of long floating plumes or bewildering maze of drooping feathers with the wire filaments projecting far beyond, there are true tail-feathers much prolonged and broadening somewhat toward the extremities. As a further mark of distinction in addition to the disproportionately long and peculiarly shaped tail, the Incomparable bears on its head a double crest of velvety feathers which flash and glitter, requiring only the light to bring out all the colours from their dull depths. The same may be said of the scales of copper and gold on the throat and breast. Equally gorgeous though without the scintillating reflections is the glossy apparel of the body and tail. The whole plumage in fact "glows with an effulgence of varied hues that almost baffle description."

To support this wealth of colour and feathers nature has furnished a pair of strong, substantial legs, very serviceable indeed for grasping branches of trees, but far from shapely. Large, ugly feet and legs, however, are the common heritage of all the birds of paradise, the only parts visible where the useful has predominated over the ornamental. This is eminently true of *Paradisea apoda* whose descriptive, scientific appellation is decidedly a misnomer. Let us not, however, now that we are convinced that *Apoda has* legs, cast the term aside, for the pretty fiction it commemorates is worth retaining. This lovely bird is almost too well known to require more than a brief notice. It was the first of its kind to become a familiar and admired object in museums as it had long been an article of commerce. This fact may have arisen partly from its abundance, its supreme beauty or the accessibility of the regions it inhabited. The specimens we see in cabinets, well mounted as they often are and carefully preserved, are dim and lustreless beside the living creatures as they flash in all the

splendor of vivid colours amid their native haunts. Here the foliaceous snow-white plumes waving in the wind, the buoyant pinions dark of hue, the brown-golden plush of the body, the violet and purple breast, the dazzling yellow of neck and head, the changing metallic green of the throat all form a picture that once seen is never forgotten. Of reduced size and of somewhat paler colors, but in other respects almost the counterpart of the *Apoda*—or Great, Common, Emerald, as it is variously called, is the Lesser bird of paradise—*Paradisea minor* or *papuana*. These two species stand in about the same relation to each another as the hairy and downy woodpeckers of our forests.

In his first visit to New Guinea in 1871, D'Albertis killed the male of a bird which is labelled in his interesting work "new genus and new species." Mr. Sclater denominated it *Drepanornis albertisii*. It certainly is very different in appearance, especially in the form of the beak, as D'Albertis points out, from other species of birds of paradise. "The beak resembles that of the hoopœ," being long and curved. The plumage lacks the velvet-like texture of other species, but is downy, while the head, although crested with curious protuberances of small feathers gleaming green and copper in certain lights, is not similar in shape. Nor can it be placed on an equality with its fellows in that beauty and arrangement of plumage we think of as typical of birds of paradise. And yet its claims are not to be slighted; its rich umber coat shines with lustre; tufts of feathers, beautifully tinted and so long as to almost enfold the body, spring from the breast and sides, and the dividing colors seem to stand out, so vivid and distinct are they. Whether open or shut the two semicircular feather-fans or shoulder-crests gleam in the light like a humming-bird's array; the same may be said of the throat and breast. Purple, violet, yellow, brown and gold, are some of the hues that chase each another over the soft plumage. The under parts from the breast to the rounded tail which is unadorned with loose plumes or elongations, are white; a roseate tinge may be seen on the spurious wings, while greyish and olive reflections appear on the edgings of both the long and short feathers. The

long, curving bill continued from a small somewhat flattened head, suggest habits akin to the sun or honey birds, and even relationship to them. The above is also called *Epimachus vethii*, vide p. 393, Vol. 28, no. 329 of Amer. Nat.

Mr. Denton, whose keenness of observation is evident in his interesting volume of personal experience as it is also in his recollection, and whose ready assistance one takes pleasure in acknowledging, likens the head of *Drepanornis* when the feathers are puffed out to that of the crested grebe. He regards it as one of the oddest, strangest and most grotesque-looking of birds.

Whether the so-called Plume birds form a distinct family as some naturalists have divided them or whether they should be ranked among the birds of paradise as merely a long billed variation—a species to which the *Drepanornis* should properly belong, certain it is that there is nothing lovelier in feathers to entitle their possessors to a classification with the peerless *Paradisea*. This much as to their appearance; as to their diet, they are both insectivorous and frugivorous feeding largely upon the fruit of the pandanus tree. The legs and feet are almost misshapen, naked along the thighs and livid in colour. The cry is long and cadenced. In essaying a description of these birds it is well to keep in mind the words Mr. Wood used in his own account. In speaking of the inadequacy of language to convey the impression the changing beauty of the plumage leaves upon the mind, he adds: "even with the assistance of colour, any idea that can be given, would necessarily be very imperfect, and the most admirable illustrations ever drawn, rich in ultramarine, carmine, and gold, would 'pale their ineffectual fires' even before the stiff and distorted form of the stuffed bird. The very respiration keeps the feathers in continued motion, causing them to change their tints with every breath, etc. This is in itself a description. In additional respects the species under consideration—the twelve-wired *Epimachus, Seleucides alba* of D'Albertis, is enshrouded in soft, loose plumage, like velvet to look upon and of the richest tone. It is a beautiful puzzle in arrangement and coloring, a poem in feathers, a symphony in the interfu-

sion of a few tints only, which might almost be reduced to mere lustrous black and orange: the body being dark of hue, while beyond and enveloping the short tail, delicate creamy-yellow plumes extend in a bewildering maze. "The bird is so gorgeous," exclaims D'Albertis, "that it is not surpassed by any other of the feathered tribe." Its distinguishing feature, unique among birds, is the display of wire feathers—six on a side, threading the intricacy of the waving plumes and prolonged several inches. These are much attenuated, black in colour and without the terminal web. They cannot be said to add materially to the beauty of the bird though they certainly do to its singular appearance. Far more attractive from an aesthetic point of view, are the recurved feathers standing out from and partly encircling the neck. These reflect from their burnished surface all flashing colours, blazing in sunlight like polished gems. D'Albertis observed that the tail of the female and young males was long in proportion to the body. There is, however, one of this interesting group of birds, the adult male of which is furnished with a tail remarkable for its excessive length; this is the *Superb epimachus—Epimachus magnus* or Long-tailed bird of paradise. Mr. Denton in his Incidents of a Collector's Rambles thus summarizes its charms:—"The plumage is a velvety-purple-black; the tail is two feet long; and the side plumes have a bar of the most exquisite green and gold, extending across the tips." In this example the coloration is even simpler than in the foregoing, that is, the ground or primitive tint is black, lustrous black, but the effect of light upon this basal colour is quite as marvellous as in any bird specimen. The play becomes always different and incessant. The black seems both suffused and shot over with emerald, turquoise, bronze, yellow, every hue you please, and this not only from the metallic surface of the wings and tail but from the soft, dark velvet of the body, as well. There is a similar collar or ruff around the neck of the Superb, as adorns the twelve-wired bird; but the tail is altogether different. Instead of the pendulous plumes which may answer for caudal ornamentation we find twelve long-extended quill feathers, the two longest in the middle, sometimes cross-

ing each other at their extremities, the lateral feathers decreasing gradually in length towards the rump. These glow with colour of a brilliancy almost equalling that reflected from the shining throat and breast. Altogether this Plume bird is a splendid representative of its race, not only in respect to its exquisite shape and coloring, but also great size, for it can boast of a total length of nearly four feet. When the mantle is uplifted, there is plainly discernible a lovely wavering crescent of blue light about an inch from the edges and reaching as far as the body. Mr. Wallace describes these broad side-plumes as dilated at their extremities; rather do they seem as if a pair of shears had clipped them before they had become fringed. Nor can it be said that the bar of quivering color extends along the tips; this must be removed as has been stated, a little space below, where, if so chameleon-like a tint can be labelled, it is a glowing azure.

When Mr. John Gould, the author of Birds of Australia and other monumental works, was at work in the Island-continent, he limited the range of the Rifle Birds to one small section of that country. Recent travellers, however, in New Guinea have found members of this interesting group there also. Mr. Octavius Stone who spent "a Few Months in New Guinea" collected the *Ptilorhis magnifica* along the southern coast, and Mr. S. F. Denton gives an engaging description of his pursuit and capture of the same. This bird is not enriched with the feathered efflorescence, if we may so term it, to the same extent as the Plume-birds to which it is allied, and the birds of paradise, but the sheen of its scale-plumage is of even greater intensity. Colours flash from head and throat with gem-like rapidity and effulgence, for these parts are covered, as it were, with bits of glittering steel that are emerald-green to look upon when the bird is perfectly still, but when a movement is made there is a sudden blaze of yellow mingled with the primal tints.

The rest of the body is of a velvety black "touched here and there with purple gleams of light." Mr. Denton calls it "one of the loveliest and richest creatures" in the world. Its note he says, is a loud and coarse croak and when it flies "every stroke of its wings squeak as if two pieces of crisp silk had been

rubbed together." The point of resemblance between the *Pliloris* and *Epimachus* is the long, curved beak. In other respects there is a marked contrast. The plumage in the former is mainly compact, and, divested of its glancing hues, is characterized by its simplicity. The tail too is not developed into a long or spreading train but is short, stout and square, serving apparently the useful purpose of a prop or assistance to the bird as it climbs on branches of trees, for its likeness to the Creepers has already been pointed out, though its large size assorts oddly with their slender frames. It is, however, not entirely without side plumes, but these are thin and scant and reach underneath scarcely beyond the tail when the wings are closed. The croak of this bird is absolutely appalling in its loudness, volume and dissonance; it may be heard half a mile or more and when once heard is never forgotten. He is strangely local in his habitat and whatever spot he has appropriated as his peculiar domain, he cannot be driven away from, nor does he endure a trespasser upon it.

There are several more species of the *Paradisea* or kindred forms yet to be described, but further consideration of them will be deferred to another occasion. Probably others are still to be discovered, and it may be, as has been asserted, that as many as forty distinct varieties of these unrivalled creatures await the admiration and wonder invariably paid them. But on the subject of the irrelevancy of man to the animate beauties of nature, some reflections of Mr. Wallace, in connection with his first sight of the King-bird of paradise, may profitably be studied.

It is needless to say that the foregoing descriptions refer in every instance to the male bird. The female, as is invariably the rule with brilliantly plumaged birds, is comparatively plain, positively so in the case of the Rifle-bird where the dullest shade of brown emitting no sparkle whatever is all that nature has allotted. She is not even graced with the two bright-green middle tail feathers which shine so conspicuously amid the dark-toned velvet of the male bird. Yet there are some examples of elegance of form and loveliness of plumage that, whether their possessors are merely paler reflections of their

mates or may be guaged on their own merits, can claim high rank in the lists of beauty. Such are, to mention two or three only, the Great and Lesser birds of paradise. It is only in the dazzling presence of their lords that the charms of the females seem dim and unimportant.

But little that is exact and trustworthy is known of the habits, modification and general life of birds of paradise. They keep to the tallest trees as a rule, with the exception of the little King-bird and the Magnificent, who favor bushes and small growths. Although not particularly suspicious they resent intrusion on their haunts, retiring out of sight quickly or screaming in vociferous tones their uneasiness. They do not, however, by any means reserve their discordant cries for occasions of alarm, but are indefatigable in uttering them at other times as well, yet a singularly sweet note heard now and then in the dense forest is accredited to one or another of the paradise-birds. From the Magnificent for instance proceeds a squirrel-like chatter that may be imitated by sucking the back of the hand rapidly. *Raggiana* too is said to make a peculiar whistle as when a man calls his dog.

At periods of mating these birds are nosiy and clamorous. It is then that the natives undertake their capture at the time when those remarkable courting-dances or displays are in progress, wherein the male, oblivious to everything but the object of his desire, is thrown into a frenzy of passion, attitudinizes in every conceivable posture and spreads out all the glories of his splendid plumage. The silent deadly blow-gun is now brought into requisition with telling effect, bird after bird falling in the interests of trade. As the *Paradisea* are by no means solitary, but, where they are met with at all, fond of associating together in small flocks, it can easily be perceived how large a supply is annually furnished to the exigencies of commerce. But this murder of the innocents, one may be glad to remember, is after all limited to a few species, for, as it has already been intimated, the majority of the different varieties are never exported—natural obstacles, scarcity of numbers or lack of demand effectually preventing.

The fruits of the teak-wood, the pandanus, etc., constitute perhaps the larger portion of the food of these birds, but their grosser appetite does not disdain an insect diet---beetles, certain kinds of bugs and locusts, not forgetting frogs, lizards and other small reptiles with which the New Guinea forests are well stocked. If one would prefer that these ethereal creatures lived upon things less obnoxious to our tastes, he may console himself with the knowledge that they occasionally partake of butterflies, which in these wilds are, in many cases, almost as lovely and aerial as the birds themselves. It is doubtful, however, if these are taken on the wing as some have fancied; the expanding plumage would seem to forbid any such attempt on the part of the pursuer even though the prey be only a slow-sailing *Lepidopter*. *Seleucides alba* is said to sip the nectar from flowers.

Of the nests, eggs and young but little is yet known although it would seem as if opportunities for such knowledge, had not been altogether lacking.

"What character,
O sovereign Nature! I appeal to thee,
Of all thy feathered progeny
Is so unearthly, and what shape so fair?
So richly decked in variegated down,
Green, sable, shining yellow, shadowy brown,
Tints softly with each other blended,
Hues doubtfully begun and ended;
Or intershooting, and to sight
Lost and recovered, as the rays of light
Glance on the conscious plumes touched here and there"?
Bird of Paradise.

—*Wordsworth.*

A colored plate of the *Drepanornis albertisii* will appear in the next number of the Naturalist.

LEUCISCUS BALTEATUS (RICHARDSON), A STUDY IN VARIATION.[1]

By Carl H. Eigenmann.

Nowhere else in North America do we find, within a limited region, such extensive variations among freshwater fishes as on the Pacific slope. This is true, whether we have reference to the extent of variation between the extremes of the same family or to the limits of variation in any given species.

A comparison of the members of the eight families of fishes having representatives on both the Atlantic and Pacific slopes, show that, on an average, each of these families has four genera and sixteen species on the Pacific slope, and seven genera and thirty-six species on the Atlantic. Yet, although the number of species is more than twice as great on the Atlantic slope, the variation in the number of fin rays among the Pacific slope species is greater in all but two families. I have recently[2] made a detailed comparison between the members of the different families, and there attributed this great extent of variation to two causes. First: the fauna is of diverse origin; some of the members are of Asiatic, while others are of Atlantic descent. Second: the fauna is new as compared with the Atlantic slope fauna, and has not yet reached a stage of stable equilibrium. It is possible, as suggested to me by President Jordan, that the Pacific slope fauna has retained its primitive characters more nearly than the Atlantic slope fauna, which shows signs of degeneration in its fins and teeth.

This great variation between the members of the same families is not confined to the fin rays. It is equally true of other characters, but can best be demonstrated in characters whose variation can be numerically expressed. The pharyngeal

[1] Contributions from the Zoological Laboratory of the Indiana University, No. 11.

[2] Results of Explorations in Western Canada and the Northwestern United States. Bull. U. S. Fish Com. for 1894, pp. 101 to 132. Plates 5 to 8. June, 1894.

teeth of the Cyprinidæ offer another striking example of these variations among the Pacific slope species. In a number of cases, the variations of the Pacific slope species extend along definite and parallel lines. I have pointed out some of these in the paper quoted above. These lines are directed towards an increase of rays and towards a modification of rays into spines.

The following quotations, from Gilbert and Evermann's recent work on the Columbia River Basin,[3] illustrate the variation among the different specimens of the same species. "The range of variation seems to be very great, and characters which are of undoubted specific value when applied to Atlantic drainage species, do not possess any such value for classification of Pacific coast fishes. Each so-called species seems to be in a very unstable state of equilibrium, and not to have yet assumed or been able to retain, with any degree of permanence, any set of specific characters." "The crosswise series of scales [in *Agosia nubila* (Girard)] varies from 47 to 70 in number; the barbel [a generic character] is present or absent; the pharyngeal teeth vary from 1,4–4,0 to 2,4–4,1; and the dorsal fin varies much in position and somewhat in size. These characters occur in various combinations, and with some of these are often correlated peculiarities of physiognomy and general appearance, all of which may serve to put a certain stamp upon the individuals from a single stream, or even from one locality in a stream." These observations, especially those contained in the last sentence, accord exactly with the results obtained by me in Leuciscus, and confirm my statement which will be further reënforced by the present paper, "that each locality has a variety which, in the aggregate, is different from the variety of every other locality."

The remarkable variation of the Pacific slope species, and more especially the variation in the fin rays, was first noted in preparing my account of the specimens collected in the Colum-

[3] Report of the Commisssioner of Fish and Fisheries on Investigations in the Columbia River Basin in Regard to the Salmon Fisheries. Washington, 1894. A report upon investigations in the Columbia River Basin, with description of four new species of fishes.

bia and Frazer Basins.[4] This variation was most pronounced in the species of the late genus Richardsonius. Of the species of this genus, I had about 250 specimens, collected in the Frazer and Columbia systems, from tidewater to an elevation of 2,786 feet. The later explorations of Gilbert and Evermann have increased this number to 825, and these warrant a re-examination of the points stated by me. For all the data concerning the fin rays of the specimens collected by Gilbert and Evermann, I am indebted to them. Their examination of these specimens was made to test certain conclusions reached by me, and their data, therefore, join mine. In counting the anal rays, I counted the rudiments at the beginning of the fin. These were not counted by Gilbert and Evermann, and to bring their data in perfect accord with mine, it is necessary to add 2 to the number of anal rays. While the number of rudimentary rays is not always 2, it is so often that the exceptions would probably not alter the general results.

At the time I began my studies of these forms, they were regarded as two species, forming a peculiar genus, Richardsonius. They were known to inhabit the Columbia River and the streams about Puget Sound. The compressed belly behind the ventral fins was regarded as the character separating them generically from the related forms. It soon became evident that, while some specimens possessed this, if constant, unquestionable generic character, others did not show it at all, and the genus was relegated to the limbo of synonymy. The species *balteatus* and *lateralis* were distinguished as follows:

a. Base of anal, $4\frac{1}{4}$ in the length; A. 17 or 18; teeth, 2,5–4,2. Lower jaw slightly projecting beyond the upper. Coloration plain; the sides bright silvery; crimson in males in spring. Scales 13–62–6. *balteatus.*

aa. Base of anal $5\frac{1}{3}$ in the length; A. 14; teeth 2,5–5,2. Jaws equal; blackish above; a dark lateral band; the interspaces and belly pale; crimson in male in summer. Scales 13–55–6. *lateralis.*

[4] This variation in the same species does not seem to be confined to the Fishes. Prof. Ritter, Proc. Cal. Acad. Sci., 2d Ser., Vol. IV, p. 37, finds the same in *Perophora annectens*, a new tunicate described by him.

No better distinguishing marks could be wished by any systematist. These characters were found to be so bridged, that the extremes could not be specifically sustained, and one of them, probably out of deference to the authority of my friends Jordan and Gilbert, from whom the above diagnosis was modified, was retained as a variety of the other. Now I am inclined to regard *lateralis* as a synonym of *balteatus* with Gilbert and Evermann, but I must take exception to the statement attributed to me that I "considered *lateralis* a subspecies of *balteatus* occupying the same brook with its parent form." I found *balteatus* at the lower Frazer to Kamloops, *lateralis* at the headwaters of the Thomson River down to Kamloops. I see no reason why a subspecies should not occupy the same "brook" with its parent form, for some allied species—between which and subspecies there is, after all, but a mental difference—are, even by Gilbert and Evermann, admitted to live side by side (*Agosia falcata* and *umatilla* at *Umatilla*).

Leuciscus balteatus ascends the tributaries of the Frazer and Columbia as high as the falls will permit. No other species is found in the Frazer system nor in the Columbia Basin proper. The specimens from Brown Gulch were described as different from those of the lower Columbia, but a comparison of large numbers from other localities has shown them to be but one of the numerous local variations. Three other species, *L. hydrophlox*, *lineatus* and *aliciæ*, are found in the Snake above the falls. The last two belong to a different section of the genus *Leuciscus*, and are not closely related to the *balteatus*. All three have probably entered the Snake River from the Utah Basin. As far as known, the territories of *L. balteatus* and *hydrophlox* do not overlap, unless those specimens of *balteatus*, with only 13 or 14 anal rays, are, in reality, *hydrophlox*, and, as far as my experience goes, the number of anal rays is the only ready means of distinguishing the two. *L. balteatus* extends up to or near to the first falls of the Snake, *hydrophlox* is found from this point to the headwaters. A comparison of *hydrophlox*, *balteatus* and *gilli*, the specimens from Brown's Gulch, makes it quite certain that they are all modifications of the same form.

Below are given a number of tables which show the variation in several characters. These tables are all from my own specimens.

From these tables it will be noticed that the number of dorsal rays is quite constant, being from 10 to 13. The variation

TABLE OF VARIATION FOR 26 SPECIMENS FROM MISSION.

No.	Length in mm.	Dorsal.	Anal.	Scales.	Teeth.*	Depth.	Position of dorsal.	Sex	Remarks.
1	140	13½	18½	12–59–6	.....	3 1-2	(†)	♀	Keel scarcely evident.
2	120	12½	21½	11–53–5	2, 5–4, 1	3 2-5	(§)	♂	Median keel scarcely evident.
3	110	13½	19½	12–60–6	2, 5–4, 2	3 2-5	(‖)	♂	Median keel moderate.
4	105	12½	20½	12–58–6	2, 5–4, 2	3 1-4	(‖)	♀	Median keel well developed.
5	100	12½	19½	11–57–6	2, 4–4, 2	3 2-5	(†)	♂	Keel typical.
6	102	12½	18½	12–60–6	2, 5–4, 2	3 1-2	(§)	♂	Keel moderate.
7	91	11½	20½	12–57–5	2, 4–3, 1	3 3-7	(‖)	♀	Keel evident.
8	92	11½	19½	12–58–6	2, 5–4, 1	3 3-5	(‖)	.....	Keel distinct.
9	88	12½	19½	12–61–6	2, 5–4, 2	3 2-3	(‖)	♂	Keel well developed.
10	92	12½	21½	12–63–6	2, 5–4, 1	3 7-8	(§)	♀	Keel typical.
11	102	12½	20½	11–62–6	2, 5–4, 2	3 3-5	(§)	♂	Keel well developed.
12	87	12½	20½	13–59–6	1, 5–4, 2	3 3-5	(†)	♂	Keel moderate.
13	86	12½	20½	11–59–7	2, 5–4, 1	3 1-4	(‖)	♂	Keel well developed.
14	83	12½	20½	12–61–7	2, 5–4, 1	3 1-2	(†)	♂	Keel no more than in *montanus*.
15	80	11½	19½	12–61–6	2, 5–4, 1	3 3-5	(†)	♂	Keel distinct.
16	95	12½	18½	13–59–7	2, 5–4, 2	3 1-2	(‖)	♂	Keel evident.
17	90	12½	17½	13–58–7	2, 5–4, 2	3 2-3	(†)	?	Keel moderate.
18	80	11½	17½	11–60–7	2, 5–4, 2	3 1-2	(†)	♂	Keel typical.
19	77	12½	17½	57	2, 5–4, 2	3 4-5	(†)	?	Keel well developed.
20	87	12½	16½	13–61–7	2, 5–3, 2	3 2-3	(§)	.....	Do.
21	81	12½	22½	12–58–7	2, 5–4, 2	3 2-3	(‖)	♀	Keel moderate.
22	80	13½	21½	61	2, 5–?	3 4-5	(‖)	♀	Do.
23	74	11½	16½	.....	2, 5–4, 2	.....	.....	.....	Do.
24	60	13½	24½	.....	2, 5–4, 2	3 4-5	†	.....	Keel evident.
25	68	13½	24½	.....	.....	.....	.....	.....	
26	64	12½	23½	.....	.....	.....	.....	.....	

* I have frequently observed that the largest individuals among the minnows usually have abnormal numbers of teeth.
† Equidistant from base of middle caudal rays and a point above middle of pupil.
‡ Anterior tooth of main row on left side is large, dagger-shaped, and remote from the others, and points inward.
§ Equidistant from base of middle caudal rays and upper angle of preopercle.
‖ Equidistant from base of middle caudal rays and posterior margin of eye.

TABLE OF VARIATION FOR 8 SPECIMENS FROM SICAMOUS.

No.	Length	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Position of dorsal.	Sex	Remarks.
	mm.								
1	82	12½	19½	11–60–6	2, 4–3, 1	4—	(*)		Keel indistinct.
2	92	12½	16½	11–62–6	2, 5–4, 2	.....	(*)		
3	90	12½	14½	14–62–7	2, 5–4, 2	3 3-5	(†)		
4	87	12½	17½	12–60–5	2, 5–4	4	.....		
5	85	12½	16½	10–62–5	2, 5–5, 3	4 1-5	(‡)		
6	80	12½	18½	11–60–6	2, 5–4, 1	4 1-4	(*)		
7	85	12½	16½	11–59–5	2, 5–4, 2	4	(†)		
8	77	12½	17½	11–61	2, 5–4, 1	4 1-5	(*)		

* Equidistant from base of middle caudal rays and upper angle of preopercle.
† Equidistant from base of middle caudal rays and a point above middle of pupil.
‡ Equidistant from base of middle caudal rays and occiput.

TABLE OF VARIATION FOR 18 SPECIMENS FROM THE COLUMBIA AT GOLDEN.

No.	Length	Dorsal.	Anal.	Scales.	Teeth.	Depth.	Head	Position of dorsal.	Sex	Remarks.
	mm.									
1	115	12½	15½	12-63-6	2, 5–4, 1	3 3-4	4 1-4	(*)	♀	Keel nil.
2	104	11½	16½	10-61-?	2, 5–4, 1	4	4 1-3	(†)	♀	Keel evident.
3	103	11½	18½	10-55-5	2, 5–4, 2	4	4 1-4	(*)	♀	Do.
4	103	11½	17½	12-59-?	2, 4–5, 2	4 1-5	4 2-7	(*)	♂	Do.
5	95	12½	15½	56	1, 5–4, 1	4	4 1-3	(‡)	♀	Keel well marked.
6	92	11½	15½	.....	..... .	4 1-2	4 1-4	(§)	?	Keel well developed.
7	91	12½	17½	57	2, 4–3, 2	3 3-4	4 1-5	(‡)	.....	Keel nil.
8	85	11½	14½	.....	.....	4	4 1-5	(‡)	.....	Keel well developed.
9	85	12½	16½	.....	... .	4 1-3	4 2-5	(§)	.....	Keel scarcely evident.
10	82	11½	16½	.....	.....	4 1-4	4 1-4	(*)	.....	Keel evident.
11	83	11½	16½	.....	....	3 5-6	4	(‡)	.....	
12	77	11	15½	.....	.....	4 1-4	4 1-4	(‡)	.....	Keel evident.
13	73	12½	15½	.....	.....	4	.....	(‡)	.....	Keel well developed.
14	72	10½	15½	.....	.... ..	4 1-3	.....	(‡)	.....	Keel moderate.
15	68	11½	16½	.....	.....	4	.....	(*)	.....	Keel well developed.
16	67	12½	17½	.....	.....	3 4-5	.....	(‡)	.....	Do.
17	65	12½	15½	....	....	4	.....	(§)	.....	Keel strong.
18	62	11½	17½	.....	.....	4 1-5	.....	.....	.....	Do.

* Equidistant from base of middle caudal rays and occiput (beginning of scaled region).
† Dorsal nearer base of middle caudal rays than occiput.
‡ Equidistant from base of middle caudal rays and upper angle of preopercle.
§ Equidistant from base of middle caudal rays and posterior margin of eye.

in the anal is enormous, but this I shall treat in detail. The scales are seen to vary from 10 to 14 above the lateral line; from 55 to 63 along the lateral line, and from 5 to 7 below the lateral line. There is nothing unusual in these variations, they are surpassed or equalled by other members of the same family. The variation in the teeth is great. With one exception, there are two teeth in the lesser row of the left side. The major row on the left side contains 4 or 5 teeth in the proportion of 1 to 6. In the right side, 3, 4 and 5 teeth were found in 4, 30, and 2 specimens respectively. In the lesser row of the right side, 13 specimens had 1 tooth, 20 had 2 teeth and one had 3. This last specimen, with dental formula 2,5–5,3, exceeds the dental formula of all the 175 Atlantic slope species of this family. Among these dental formulæ we find variations, the extremes of which have been taken as generic characters in other members of the Cyprinidæ.

The different combinations of teeth and the number of specimens having each number are as follows: One with 1,5–4,1; one with 1,5–4,2; two with 2,4–3,1; one with 2,4–3,2; one with 2,4–4,2; one with 2,4–5,2; one with 2,5–3,2; eleven with 2,5–4,1; sixteen with 2,5–4,2; one with 2,5–5,3. The usual or normal

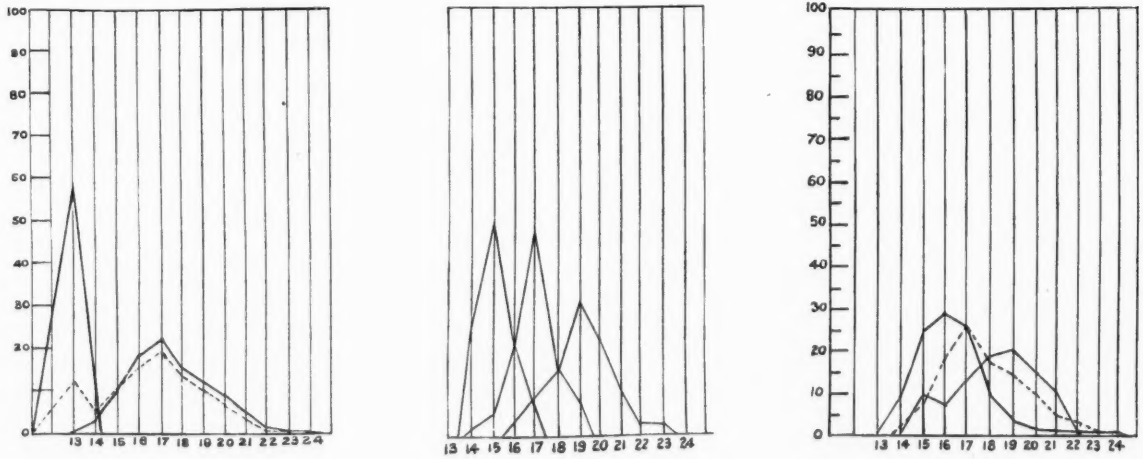
formula is 2,5–4,1 or 2. The variation through ten different combinations is exceptional.

The proportions, while varying considerably, do not show any wider fluctuation than usual. The position of the dorsal, on the other hand, varies considerably.

In the development of the keel behind the ventral fins we find again a great fluctuation in specimens from the same locality. In some, the keel is very sharp; in others, it is entirely absent, and between these forms, we have all shades of variation. If uniform, it would be of generic value.

Now, as to the variation of the anal rays. The lowest number recorded is 13 (after adding 2 to Gilbert and Evermann's lowest number), and the highest is 24. This gives a total variation of 12 rays. This would be a large variation for any fish but ,becomes phenomenal when it is considered that the variation in the number of anal rays of the 175 Atlantic slope species extends only from 6 to 14, a total variation of but 9 for 175 species as compared with the variation of 12 for a single species. The high number of rays reached is also phenomenal, for, leaving out of consideration the two rudimentary spines, the highest number of anal rays—22—is ten more than the number found in any other Pacific Cyprinoid, and 8 more than the number found in any Atlantic species. The average number of rays is 17. The variation to lower numbers extends through 4 rays to 13. The variation to higher numbers is much greater, extending through 7 rays to 24. Not only is the extent of variation greater towards higher numbers, but the number of specimens varying in that direction is much greater. Of 825 specimens, but 22.3 per cent. have the average number of rays. This is the largest per cent. for any given number of rays. Thirty-four per cent. of all the specimens have fewer than the average number of rays, while 42.9 per cent. have more than the average number. A more striking illustration of determinate variation could not be wished. Fig. 1 graphically represents the variation of the species as shown by the 825 specimens examined. The total height of the vertical lines represents the greatest possible number—100 per cent—that could have the given number of anal rays indicated at the

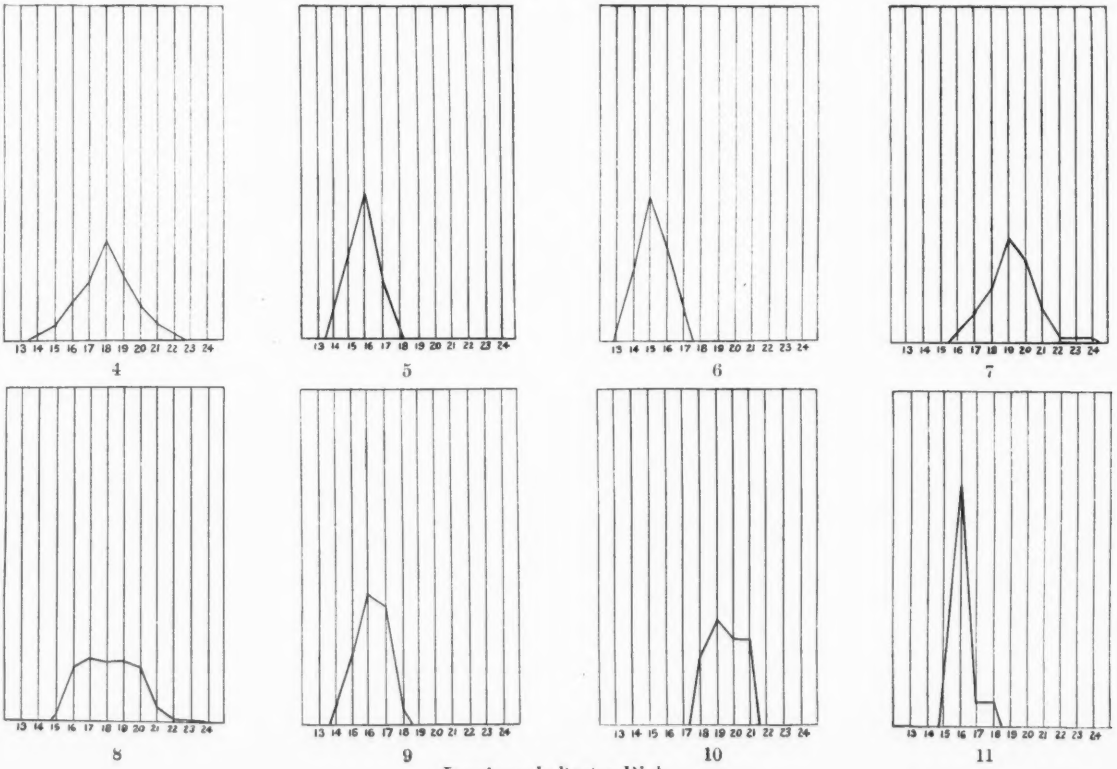
PLATE I.



1 2 3

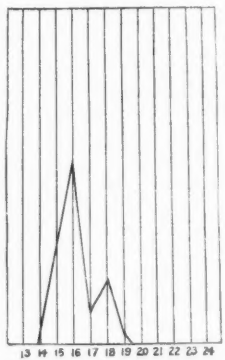
Leuciscus balteatus Rich.

PLATE II.



Leuciscus balteatus Rich.

PLATE III.



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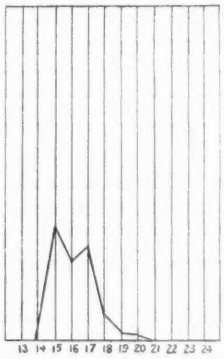

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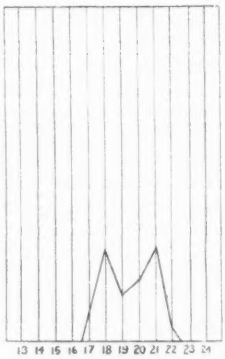

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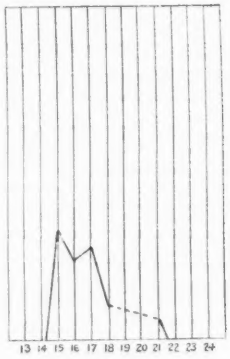

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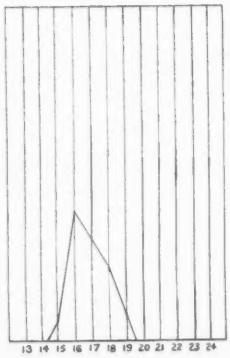

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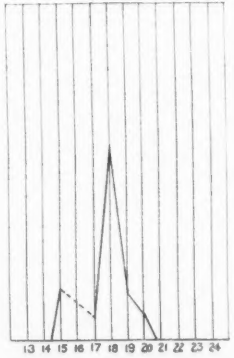

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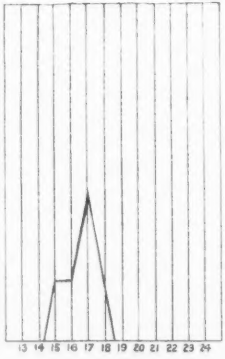

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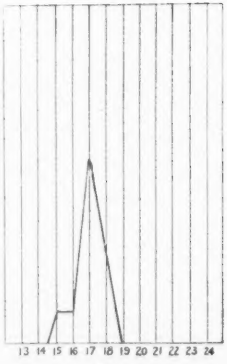

19

Leuciscus balteatus Rich.

PLATE IV.

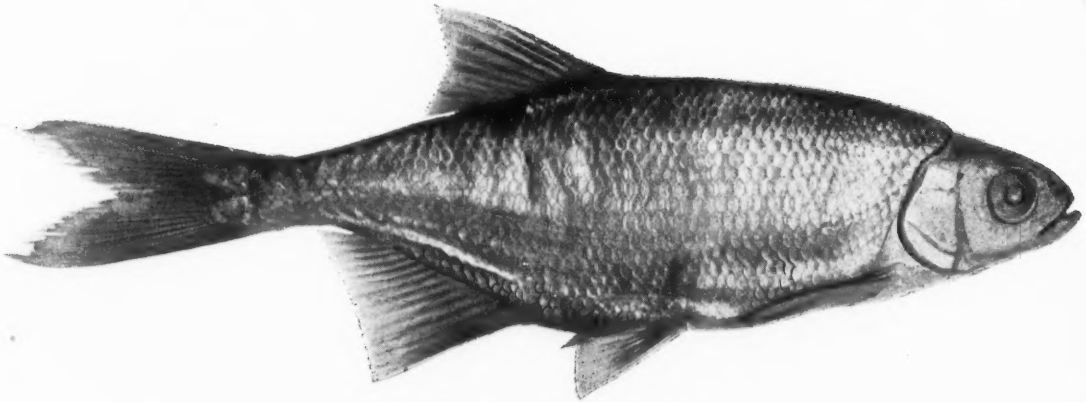

FIG. 20.—*Leuciscus balteatus* Rich.

PLATE V.

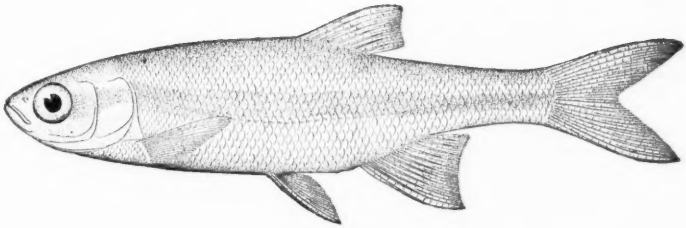

FIG. 21.

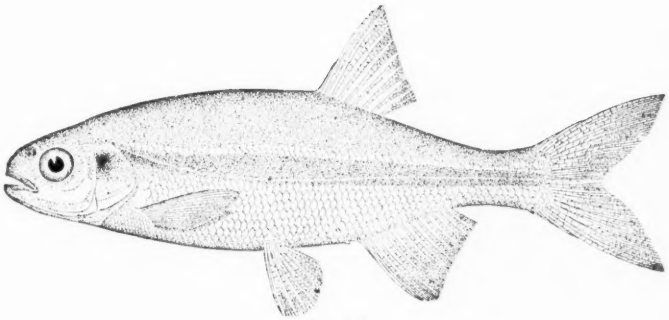

FIG. 22.

FIG. 21. *Leuciscus gillii.* FIG. 22. *Leuciscus hydrophlox.*

bottom of the lines. The curve shows the actual per cent. of specimens having each particular number of rays. Were the variation promiscuous, the curve would be symmetrical. The asymmetry shows the inherent tendency to higher numbers of rays in this fish. It may be well to bear in mind that no other species has a higher number of rays, that no other species joins this curve on the right, while at least one, probably two, related species living in the headwaters of the Snake River have fewer rays, *i. e.*, joins this curve on the left. The curve of *Leuciscus hydrophlox* not only joins this curve, but overlaps it, showing that in the number of anal rays *L. balteatus* and *L. hydrophlox* intergrade.

To facilitate the study of the local variations, I give below all the data concerning the 825 specimens of this fish. The first column gives the name of the stream and locality; the second column gives the elevation of the locality; the third the number of specimens collected at the given place; the fourth the extent of variation in the anal rays in the specimens from the locality, and the succeeding columns the number of specimens having the particular number of anal rays indicated at the head of the columns. The figures in the column representing the average number of rays for the specimens of the locality are in heavy face type.

After a detailed examination of the specimens collected by myself, I found that every locality has a variety peculiar to itself. The number of localities has been trebled by the explorations of Gilbert and Evermann, and the number of specimens raised from 250 to 825, and their detailed examination of these specimens bears out the above statement for every locality examined by them. Unfortunately, they allowed themselves to be side-tracked by minor issues, and did not mention this fact of local variation except in connection with other species.

I collected at three localities in the Frazer Basin. At Mission, B. C., I obtained 79 specimens in water which is affected by the high tides. At Sicamous, at an elevation of 1300 feet, I collected 58 specimens. At Griffin Lake, at an elevation of

DETAILS OF THE VARIATIONS IN THE ANAL RAYS.

Locality.	Elevation.	Num. of specimens.	Variation.	Number of Anal Rays.											
				13	14	15	16	17	18	19	20	21	22	23	24
Payette River, Payette	2150	154	9			3	25	29	**27**	28	25	12	3	2	
Boise River, Caldwell	2372	99	9		2	4	11	17	**29**	19	10	5	3		
Frazer River, Mission	1	79	9				2	7	13	**25**	18	8	2	2	2
Little Spokane River, Dart's Mill	1850	70	5	1	14	**30**	19	6							
Small Creek, at Sand Point, Idaho	2100	67	6			2	19	**36**	3	6	1				
Shuswap Lake, Sicamous	1300	58	6		1	3	13	**28**	8	5					
Lake Washington, Seattle	1	47	7		1	16	**11**	13	4	1	1				
Umatilla River, Pendleton	1070	26	5		1	5	**10**	9	1						
Grand Ronde, La Grande	2786	23	4		2	6	**11**	4							
Umatilla River, Umatilla	300	22	6					2	6	**3**	4	6	1		
Colville River, Meyers Falls	1200	21	7			7	**5**	6	2			1			
Columbia River, Golden, B. C	2550	18	5		1	7	**5**	4	1						
Clear Water River, Lewiston	750	16	4						3	5	**4**	4			
Griffin Lake	1990	14	4		3	**7**	3	1							
Brown Gulch, Silver Bow	5344	14	4			2	**10**	1	1						
Skookumchuck River. Chehalis	204	13	6			2		1	**7**	2	1				
Spokane River, Spokane	1910	11	5		1	1	**5**	1	3						
Hangman Creek, Spokane	1910	11	4			2	2	**5**	2						
Flathead Lake	3100	11	4			1	1	**6**	3						
Snake River, Payette	2150	10	5						1	1	**4**	3	1		
Natchess River, North Yakima	1078	8	5		1		3	**1**	3						
Pend d'Oreille River, Newport	2000	8	3				**5**	1	2						
Walla Walla River, Wallula	326	6	4						2	**2**		2			
Post Creek, Flathead Lake	3100	6	3					**4**	1	1					
Potlatch Creek, Lewiston	1200	4	3						1	**1**	2				
Thompson River, Kamloops	204	3	2					**2**	1						
Newaukum River, Chehalis	375	3	3							1	**1**	1			
Columbia River, Pasco	1158	4	3					1	1		1		1		
Columbia River, Revelstoke	1475	1	1			**1**									

1900 feet, I secured 14 specimens. Four others were secured at Kamloops, but these are too few to aid us in our study.

The variation for these localities is represented by the three curves of figure two. The vertical lines stand for fin rays to total height of the figure for 100 per cent. The various heights of these curves represent the per cent of specimens having the given number of rays. The variation is seen to be much the greatest at Mission, a fact which is largely to be attributed to the greater number of specimens secured at this

place. The variation from the normal, which is 19 rays, to a higher number of rays, is as great as the entire variation for the next locality. At Sicamous, a much larger per cent. has the normal number of rays, but the normal number has been decreased to 17. The curve for Griffin Lake is interesting, because the normal number of rays has again been decreased by two. In other words, the higher the altitude the fewer the number of rays and the narrower the limit of variation.[5] Moreover, the curves are not symmetrical for any of the three localities, but, in the aggregate, the more gradual slope is on the side of an increase in the number of rays, a condition, which, considering the general variation of rays on the Pacific slope, seems to indicate that the number of rays of this species in the Frazer system is increasing, and that the increase is progressing from lower to higher altitudes.

A glance at the remaining curves will be sufficient to show that no two curves are alike, that the per cent. of specimens having a given number of rays differs with each locality. Naturally, the curves constructed from a large number of specimens represent the true conditions better than the curves constructed from but few. The extent of the variation varies largely with the number of specimens examined; that is, the probability of securing extremes becomes greater with an increase in the number of specimens collected. The greatest extent of variation for any locality, as far as known, is through 9 rays. This has been found only when over 70 specimens have been compared. It decreases to about 5 rays with 10 specimens. The total variation for the species has not been found at any one place.

The question of variation, with elevation, is an interesting one, and may be taken up in some detail.

In the following table, *all* the localities are grouped, according to their average number of rays.

[5] In their recent paper, Gilbert and Evermann have raised this specific statement, which occurs in my paper quoted above, into the dignity of a "theory" and "generalization" which it was never intended to be, and their arguments against it as a "theory" and "generalization" are, therefore, not appropriate.

Average number of rays.	Number of localittes.	Localities with their elevations in feet.
15	3	Little Spokane River, 1850; Griffin Lake, 1990; Revelstoke on the Columbia, 1475.
16	8	Lake Washington, 1; Umatilla River, Pendleton, 1070; Spokane River, 1910; Colville River, Meyers Falls, 1200; Columbia River, Golden, 2550; Grand Ronde River, La Grande, 2786; Silver Bow, Brown's Gulch, 5344; Pend d'Oreille River, Newport, 2000.
17	7	Newaucum River, Chehalis, 204; Natchess River, North Yakima, 1078; Sicamous, 1300; Hangman Creek, Spokane, 1910; Small Creek, 2100; Post Creek, 3100; Flathead Lake, 3100.
18	3	Payette River, 2150; Boise River, Caldwell, 2372; Skookumchuck River, Chehalis, 204.
19	5	Mission, 1; Umatilla, 300; Walla Walla River, 326; Potlacth Creek, 1200; Kamloops, 1158.
20	3	Clear Water, Lewiston, 750; Snake River, Payette, 2150; Columbia River, Pasco, 375.

The lowest average, 15, is found in but three localities, the lowest of which is at an elevation of 1475 feet. This last is of no value, since only one specimen was obtained and the chances are against an average specimen if only one is taken.

The second average is found all the way from tidewater to an elevation of 5344 feet. It is, however, notable that only one of the localities, Lake Washington, which does not belong to one of the two large water systems, is at a low elevation. The lowest of the other seven, all of which belong to the Columbia system, is at an elevation of 1070 feet.

The third average, which is also the general average for all the specimens, is found in seven localities, the lowest of which is at an elevation of 204, the highest at 3100. All but the first, which again does not belong to one of the larger river systems, are at an elevation above 1000 feet.

The fourth average ranges from 204 to 2372 feet.

The fifth average, 19 rays, is found in five localities, three of which are below 1000 feet and the highest is at 1200.

The sixth average, of 20 rays, varies from 375 to 2150 feet; two of them are at an elevation of less than 1000 feet.

This grouping does not show any uniform variation with the altitude. It may be emphasized that the lowest average is

not found below 1475 feet, that only one of the seven having an average of 16 rays is found below 1000 feet, and that but one of the eight having an average of 17 rays is found below 1000 feet. From the last but three specimens are known. It may be further emphasized that three of the five localities having an average of 19 rays, are found below 1000 feet, and that two of the three having an average of 20 rays are found below 1000 feet. Generally, the lower localities have the larger number of rays, to which there are several notable exceptions —Lake Washington and Snake River at Payette. These facts can be presented in curves for groups of localities. Taking the specimens from the different groups of localities we obtain the following:

Elevation.	Number of localities.	Number of specimens.	Extent of variation.	General average of anal rays
Feet.				
1 to 750	8	189	11	18.4
1078 to 2000	12	234	10	16.6
2001 to 3100	8	388	10	17.5
5000 to ——	1	10		16.

Whether we consider the number of localities having a high average of rays, or whether we consider the average of all the specimens from a similar horizon, we find that the largest number of rays is found in the lower horizon. Furthermore, the extent of variation for the 189 specimens, from 1 to 750 feet, is greater than the variation for 234 and 388 specimens of the higher horizons. The variation for these three horizons is given in the three curves of figure 3.

In the above we have considered the localities regardless of the system to which they belong. Lake Washington and the Newaukum and Skookumchuck Rivers belong to separate short water courses. Eliminating these and considering the localities of the Frazer and Columbia systems separately, we get the conditions described for the Frazer system above and for the Columbia system the following, arranging the localities in the order of elevation:

Locality.	Elevation.	Average number of anal rays.
Umatilla,	300	19
Wallula,	326	19
Pasco,	375	20
Lewiston,	750	20
Pendleton,	1070	16
Yakima,	1078	17
Colville,	1200	16
Potlatch,	1200	19
Revelstoke,	1475	15 (only one specimen).
Little Spokane,	1850	15
Spokane,	1910	16
Hangman Creek,	1916	17
Pend d'Oreille,	2000	16
Small Creek,	2100	17
Payette,	2150	18
Snake River,	2150	20
Caldwell,	2372	18
Golden,	2550	16
La Grande,	2550	16
Flathead,	3100	17
Brown's Gulch,	5344	16

Summarizing this: Below 1000 feet the averages are 19 and 20; above 1000 feet only one averages 20, only one reaches 19, two reach 18, four have 17, seven have 16, and two have 15. These figures "are not so unanimous in their indications" of a decrease of rays with an increase of altitude as those for the Frazer system. But the lower locality generally possesses a high number of rays. Here, where we have data from many widely separated branches, a close variation of rays, with altitude, is not found. Local issues have modified national tendencies among these fishes in the Columbia system.

Among the locality curves (figures 4 and following) the ideal curve is most nearly approached at Caldwell. The variation from the average is here equally great in both directions; and the curve of the ascending variation is almost identical with the curve of the descending variation. Nearly as ideal condi-

tions are found at Little Spokane, where the extent of variation is much smaller. *A priori* such symmetry or approach to symmetry is to be expected for each locality, but the deviations from it are many and great. The many shoulders and peaks in localities from which but few specimens have been collected, indicate probably nothing so much as the lack of a sufficient number of specimens. When but ten specimens are examined, each specimen, more or less, makes such a vast difference in the character of the curve that the localities with less than 20 specimens may be dismissed without further notice.

Aside from curves, such as that of Little Spokane, where a certain number of rays is the predominant one, we have curves such as that of the Payette River, where the number of specimens having 16, 17, 18, 19 and 20 rays, is nearly equal. Still another type of curve is represented by the curves for Lake Washington, Colville and Umatilla, in which two numbers predominate, with the intervening numbers in minority. The conditions are most marked at Umatilla, where we have two incipient varieties with 18 and 21 as the predominating number of rays.

I have given, at the outset, the probable causes which have brought about the great differences between the Pacific slope fishes.

We must look to other causes for the great variation between species of undoubted Atlantic origin, and especially the variation in the same species, which reaches its culmination in *Leuciscus balteatus* and *Agosia nubila*. The climatic, altitudinal and geological differences in the different streams, and even in the length of the same stream, are very great on the Pacific slope. To these different environments we must attribute the conditions set forth in the present paper for *Leuciscus balteatus*. These differences in different localities in the same stream can only become established in nonmigratory species. No such differences are to be expected for a migratory species. To a migratory species, such as the species of Salmo, different rivers bear the same relation as different localities on the same river to a non-migratory. Isolation for the specimens of

any locality, when free intermigration is possible, seems strange. An analgous condition is to be found on the Galapagoes Islands. Dr. Baur tells me that islands within plain sight of each other harbor distinct varieties of the same species of birds which could readily intermigrate, but do not.

This raises the question of the sort of influence exerted by the environment. Is it merely selective, or is it directive? Is the variation promiscuous and inherent in the species, or is it determinate and forced in certain directions by the environment? The latter seems to me the better way of reading such conditions as are represented by the many curves which show a greater variation towards an increased number of rays than towards a decrease of rays. Here the variation is not promiscuous, but definitely determinate. See, in this connection, the curve for all the specimens.

The origin of new varieties is admirably illustrated by the curves for Lake Washington and Umatilla. In these, two distinct peaks are found. While no varietal value is claimed for these peaks, isolation of members of such peaks, either physiologically or locally, would tend to establish such incipient varieties.

Explanation of Figures.

The vertical lines, in all cases, stand for a definite number of anal rays. The total height of the figures represent 100 per cent., and the height of the curves, at any point, the per cent. of specimens having the particular number of rays in the anal.

Fig. 1. Curve of variation for 217 specimens of *Leuciscus hydrophlox* from the upper Snake, and for 825 specimens of *Leuciscus balteatus* from many localities, varying from 1 to over 5000 feet in elevation.

a, the two series of specimens are combined in the broken line curve.

Fig. 2. Three curves showing the variation of the three localities represented from the Frazer system:

Griffin Lake, 1900 feet, 17 specimens.

Sicamous, 1300 feet, 58 specimens.

Mission, 1 foot, 79 specimens.

Fig. 3. Three curves showing the variation:
a, of 234 specimens from 1000 to 2000 feet elevation.
b (broken line), 388 specimens from 2000 to 3000 feet elevation.
c, 189 specimens from 1 to 1000 feet elevation.
Fig. 4. Variation of 99 specimens from Caldwell, 2372 feet.
Fig. 5. Variation of 23 specimens from La Grande, 2786 feet.
Fig. 6. Variation of 70 specimens from Little Spokane, 1850 feet.
Fig. 7. Variation of 79 specimens from Mission, 1 foot.
Fig. 8. Variation of 154 specimens from Payette River, 2150 feet.
Fig. 9. Variation of 26 specimens from Pendleton, 1070 feet.
Fig. 10. Variation of 16 specimens from Clearwater, 750 feet.
Fig. 11. Variation of 14 specimens from Brown's Gulch, 5344 feet.
Fig. 12. Variation of 67 specimens from Small Creek, 2100 feet.
Fig. 13. Variation of 47 specimens from Lake Washington, 1 foot.
Fig. 14. Variation of 22 specimens from Umatilla, 300 feet.
Fig. 15. Variation of 21 specimens from Colville, 1200 feet.
Fig. 16. Variation of 18 specimens from Golden, 2550 feet.
Fig. 17. Variation of 13 specimens from Skookumchuck, 204 feet.
Fig. 18. Variation of 11 specimens from Hangmans Creek, 1900 feet.
Fig. 19. Variation of 12 specimens from Flathead Lake, 3100 feet.
Fig. 20. *Leuciscus balteatus* from Mission, the specimen now in the British Museum.
Fig. 21. *Leuciscus gilli* from Brown's Gulch.
Fig. 22. *Leuciscus hydrophlox.*

The last two cuts are reproduced by permission of Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries.

ON THE EVOLUTION OF THE ART OF WORKING IN STONE.

By J. D. McGuire.

A REPLY TO MR. CHARLES H. READ.

There appeared in the American Naturalist for December, 1894, a communication by Mr. Read, one of the keepers of the British Museum, in reply to my paper on working in stone. Mr. Read having "given attention to the problem itself" thinks it "necessary to point out the danger that lies in the use of improper or irrelevant evidence;" he thinks the paper "so persistent in its pursuit of will-o'the-wisps that a better text could scarcely be found."

As Mr. Read represents the typical European believer in a palæolithic period, as distinguished from the neolithic, and as the writer calls in question the correctness of this distinction, it may be well that the public shall have an opportunity to decide who is chasing phantoms.

Mr. Read himself calls the question a "puzzle," the writer considers it a plain subject having little difficulty of solution. The original paper discussed the matter chiefly from a technical standpoint and showed, that among European writers on the subject there was absolute contradiction, and the greatest uncertainty.

There is nothing in the writer's paper calculated to mislead any one, for where experiment showed a condition, it was stated; and where an author was quoted, his name was given.

A great many American archæologists deny that the question is a "puzzle" as alleged by Mr. Read, although they confine their expressions to American conditions. The writer has not hesitated after a most thorough investigation to say that European authors *do not* agree even among themselves on the subject.

In the original paper it was stated "that a person capable of chipping out a palæolith after at most, a year or two spent

in such manipulation, would have acquired the skill requisite to batter an implement into shape, and subsequently, if necessary, to grind a blade to it." The expression was thought to be considerate of the feelings of those who advance the untenable theory that man lived through centuries upon centuries of time, chipping stones, and never battering them into shape, nor even learning the process by which it was done; when as a fact, the art of chipping, if attempted upon a granular, igneous or metamorphic stone, of which implements are commonly made, would by that very act become a *battering process;* for such stones do not chip when struck an ordinary blow.

This is not a "theory" nor is it "based upon the writers own experience as an amateur maker of stone implements." Mr. Read has not been particular in the selection of the terms used, so it may be appropriate to say here that the writer has made few stone implements, and those few are exhibited in cases in the U. S. National Museum along with the tools with which they were made, and all are numbered and labeled. In doing the work, much material was necessarily destroyed, but the results appear fully to justify the expenditure, and are considered as valuable by those who have given them careful scrutiny.

Mr. Read is unfortunate in asking if the writer has ever seen a specimen of Kafir or Polynesian carpentry, and says "both cut everything from the solid," and because the British Museum possesses specimens of chairs, with legs and backs similar to European furniture, but cut from solid blocks, asks "Are we to think that they began with joining, *without doubt the easier method,* and finally came to the more difficult, the cutting from the solid?" "Surely not." Mr. Read says "the natural explanation is the best, simply that the easier method did not occur to them."

Let us answer this fully. The writer has seen Polynesian and African carpentry, in both of which the U. S. National Museum is rich, but these people do not differ in that respect from most, if not all other savage races of the world in cutting almost everything from the solid. Mr. Read's assertion that

joiner work is simpler than working from the solid, will not be accepted on this side of the Atlantic, and any farmer's boy would laugh at such a suggestion even in England if he believed it to be seriously made. It is difficult to imagine how Mr. Read can suppose a chair with back and legs could be made out of wood by joining more easily than from the solid, if he thinks for one moment of the boring and mortising necessary in joiner work. Not only the operation but also the tools used in joiner work are more complicated than in carving from the solid.

It is a pleasure to hear Mr. Read express his preference to speak of palæolithic man in Europe, for in America the friends of palæolithic man have with few exceptions deserted the proposition as an unsupportable theory.

Mr. Read asserts that the writer's "views" are at a variance with that of others, and says: "Palæolithic implements are made chiefly of flint and quartz;" this is one of the great troubles, for if an igneous, granular or metamorphic stone is found ground into an implement, European archæologists insist that the article is neolithic, apparently not appreciating that the stones enumerated cannot be chipped. Flint implements require chipping; cliorite, on the other hand, requires battering.

The writer advisedly speaks of "stone" for the subject of the paper is stone and not *flint* as Mr. Read would have it. The writer's assertion is plain and is repeated, the process of *battering* a material is simpler than the process of *chipping* a material. The writer regrets that "it seems inconceivable that such a statement could be calmly made, seeing how entirely contrary it is not only to the experience of all who have tried the experiment, with the single exception of Mr. McGuire, but also in direct opposition to all the evidence on the subject." Mr. Read is here again decidedly confused in his mechanical methods and information, for until the writer demonstrated the process of battering, and showed it to be common to the whole world, it was declared to be a problem in archæology that was unsolved and not demonstrable, there-

fore, except the writer's paper on the subject, there does not appear to be any evidence one way or the other.

Again, Mr. Read asks "Can Mr. McGuire point out a single instance of a polished implement being found on an admitted palæolithic site?" If a palaeolithic site is one on which no battered or polished stones are found, No! In compliance, however, the writer will cite the upper cave of Wierszchow in which a polished celt of diorite was found; in this cave were also *Ursus spelaeus, Hyaena spelaea*, etc., according to Dr. Ferd. Römer, nor is this the only cave by any means. For fear, however, lest the advocates of palæolithic man may say this is not an admitted site, we will refer to the bone caves of France, admittedly of the palæolithic period. In them carved antlers are *commonly* found, and ivory tusks worked into plates; to shape which required sawing and grinding, work *similar* to that on the typical neolithic implements. The caves of England have produced bone needles *ground* into shape. Many caves of the continent have produced whistles and various other objects of stone, shell, bone and ivory having holes *bored* through them. These articles are all found in Quaternary strata, and are referred to by most all archæologists as palæolithic. To work such material (it being harder than much of that of the neolithic period, requiring similar treatment to that requisite to produce the neolith) certainly required a similar mechanical ability in the people of the earlier when compared with that possessed by those of the later period, yet if this be admitted, the palæolithic period thereby collapses.

It does not savor of fairness for Mr. Read to say the writer "is fighting air, to bring a long array of his own experiments to prove that palæolithic man ought to have found out what he considers the easiest way of making his tools." If the articles quoted above were found where their Europeon authors say they were, of which too there appears no doubt, is there not something more substantial than "air" in the argument?

The statement that "the fact that palæolithic man *overlooked* the polishing of his implements is a mere accident, a subsidiary and incidental peculiarity, and possesses no right to the importance it has obtained" is choice verbiage, but is not argu-

ment calculated to support the theory of the correctness of palæolithic man or of such a period.

American archæologists are unwilling to rely upon the soundness of arguments that appear to be intended to charge, that those who do not blindly follow European dicta, are incapable of expressing opinions of value. Sir John Lubbock's definition of "palæolithic" and "neolithic" broadly given, is a distinction of the intelligence of the peoples of the two periods as evidenced by the articles of their handiwork, and yet holds good.

The reputation gained by that patient French archæologist, Boucher-de-Perthes in his investigations in the valley of the Somme, was well deserved, but the same cannot be said of those others who are endeavoring to discover new eras of man's existence, extending over eons of time, and through gradations of chipping their tools in periods christened "pre-palæolithic," "eolithic," "mesolithic" and the various cave periods, the names alone of which, are sufficient to convince thoughtful persons that they are on doubtful ground.

The history of these newly christened eras has been that, by the time their sponsors become familiar with the names, they abandon them, until now the structure has crumbled so absolutely that a geological stratum alone decides the question, and if specimens are found in it, no matter how finished they be, whether chipped or polished, they will be accepted. The libraries of America are well stocked in archæological literature. American students have done some good work; they are willing to welcome intelligent inquirers to the fold, as there is abundance of room. Yet Americans are fast recognizing a rule, that where assertions are made archæologically, they demand a reference to the locality or the author or the specimen, and they are unwilling to accept a guess. Palæolithic man has been a fad for years, a myth and phantom, who whether he will or no, must give way to man a reasoning being, an intelligent and implement using creature.

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RECENT LITERATURE.

Packard, on the Inheritance of Acquired Characters.[1]— The time has not yet come for deciding the question which is the nearer right, the neo-Lamarckian or the neo-Darwinian school. Both have their arguments to advance and both find facts not easily to be explained by theories of the other. Yet, to us, it seems that a portion of the difficulties seem to lie in language rather than in views, and that not a little of the confusion is one of words. What Professor Packard has to say must necessarily attract attention, and, while not attempting to criticise his article as a whole, the reviewer would point out that apparently our author has been troubled by Weismann's terminology, and does not clearly appreciate the limitations placed by the Freiburg zoologist upon the expressions acquired characters, congenital variation and the like. Thus (p. 345) Packard quotes the experiments of Paul Bert upon Daphniæ, in which the adults were killed with salt water while the eggs in the brood-sac survived, as "a case in favor of the neo-Lamarckian principle," by which we suppose him to mean that the young inherited an acquired character before the parents had acquired it!

Again (p. 339), we read, "If congenital characters are the only ones which can be inherited, they must have, in the beginning, originated from those acquired during the lifetime of the individual, or, if not in the first, in the second or third, or a later generation." Here the answer is easy, the word "acquired" is used with a significance totally different from its limitation by Weismann, and it is upon this misuse of terms that our author is led into this later inquiry, "If there were no such thing as the transmission of characters, either anatomical, physiological or mental, originating during the lifetime of an organism, how should we have any evolution resulting in the different groups of organisms?" It is, it seems to us, this confusion of words which is at the bottom of Professor Packard's trouble. We think that a careful reading of Weismann's "Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung (1887)," will show one easy way out of this difficulty; whether it be the right one or not, we are not ready to say.

[1] On the inheritance of acquired characters in animals with a complete metamorphosis. Proc. Am. Acad. Arts and Sciences, XXIX, pp. 331–370, 1894.

In another place, Dr. Packard quotes the fact that Bacteria can be altered by changed environment, but has not Weismann pointed out that the unicellular forms stand upon an entirely different basis from the many-celled species, and that acquired characters must be transmitted among them? Aside from some features like this, Professor Packard's paper must be regarded as a strong presentation of the neo-Lamarckian position.

Proceedings of the Indiana Academy of Science for 1893.—Among the foremost of the State scientific organizations is the Indiana Academy of Science, the third volume of whose Proceedings is before us. Of its 274 pages, 70 are occupied by the papers read at the annual meeting in the holidays a year ago, among which especially noticeable are the presidential address of Dr. J. C. Arthur upon "The Special Senses of Plants;" E. W. Olive's paper on the "Histology of the Pontederiaceae," and Professor Eigenmann's "Effect of Environment on the mass of Local Species." More important than these is the account of the work outlined and that already done towards a Natural History[2] Survey of the State. Necessarily, the matter presented is preliminary; a getting together of bibliographies and lists of species, but so enthusiastically has the beginning been made, that we doubt not that in a few years the whole Natural History of the State will be adequately understood. For many years Indiana has maintained a so-called geological and natural history survey, but so thoroughly has this been dominated by politics that but little good has been accomplished by it. One geologist would scarcely get the harness on when a new election would put a new person in the office, a condition which has been fatal to any definite policy. But worst of all has been the fact that nominations, for many years past, have been controlled by party pull, fitness for the position not being at all essential. The result has been that since the days of Cox and Collett, the office has been occupied by persons who, no matter how estimable they may be, are unknown to the world of science, and their reports have been scarcely more than a waste of so much good paper. This year it is true, the standard has again been raised, but this is but one of the accidents of a thoroughly pernicious method. The next election is apt to replace the present incumbent by one as ill adapted for the place as some of his predecessors.

[2]Although it includes Geology, the Survey is throughout spoken of as the "Biological Survey."

Now the Academy comes forward with its plans for a complete survey, and in this laudable undertaking it should have every encouragement. With a resident membership of over 100, there is a chance for more thorough and more careful work than can ever be attained in any other way, while, naturally, as long as the Academy has such leaders as Arthur, Butler, the Coulter brothers, Eigenmann, Hay, Mottier, Underwood, etc., we may be sure that fitness, rather than any other qualification, will determine the assignment of special work. With these conditions, would it not be well for the next Legislature to do away with its comparatively useless State Geological Survey and turn over to the Academy, of course with proper restrictions, the funds which are now annually given to the former organization. At any rate, the people of the State should encourage the Academy in its endeavors, and the State itself should be willing to defray at least the expense of publishing results as valuable as these will undoubtedly be.

General Notes.

MINERALOGY.[1]

Identity of Rhabdite and Schreibersite.—The fine needles of phosphide of iron and nickel which in many meteorites accompany or take the place of the larger crystals or lenses of schreibersite, go under the name of rhabdite. Whether rhabdite is identical with schreibersite has long been in question. After carefully separating the material from the matrix, Cohen[2] has made analyses of rhabdite from five localities with the following results:

	Fe	Ni	Co	P
1. Seeläsgen, Prussia	49.76	36.17	0.46	13.61
2. Lime Creek, Ala.	51.10	32.99	0.42	15.49
3. Bolson de Mapimi, Mexico.	52.54	31.71	0.72	15.03
4. Sancha Estate, Cape Colony.	55.30	28.78	0.60	15.32
5. Hex River Mts., Cape Colony.				
a) needles	56.71	27.36	0.47	15.46
b) plates	62.45	21.71	0.35	15.49

These analyses show the formula of rhabdite to be $(Fe\ Ni\ Co)_3\ P$ or identical with that of schreibersite. Kamazite is found to be like taenite, an alloy with narrow limits for the variation of cobalt and nickel. Wülfing[3] has published a handy list of the meteorites in the world's collections.

English's New Catalogue of Minerals.[4]—The average trade catalogue of minerals is unsatisfactory because it fails to supply desired information concerning crystallography, occurrence, locality, etc. The recent catalogues of English and Company have shown a great advance over this type of catalogue, in, that beside the needed information concerning the locality, there has been added, in the case of recently described occurrences, a reference to the original description. Another valuable feature is the insertion of miniature cuts indicating the devel-

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Ann. k. k. naturhist. Hofmuseums, ix; Heft 1, pp. 97–118, 1894.

[3] Jahresheft d. Verein f. vaterl. Naturkunde i. Wurtemberg, Jahrg. 1894, pp. 1–21.

[4] Catalogue of Minerals, Geo. L. English & Co., 16th ed., pp. 124. New York, June, 1894.

opment of crystallized specimens. This mode of illustration can hardly be carried too far to suit the taste of the professional mineralogist, but as it involves expense and time in the preparation of the catalogue, we would suggest that the particular combination exhibited by a crystal might nearly as well be indicated by the use of form symbols. The sixteenth edition of English's catalogue contains a classified list of mineral species arranged like that in Dana's "System" (6th Ed.), in which is given after each species the symmetry, hardness, specific gravity, and chemical composition. A supplement to the list includes the species mentioned in Dana's supplement as well as minerals of more recent description. The book is quite free from errors and contains an alphabetical index. Only about one-third of the book is devoted to advertising.

Leadhillite from near Granby, Missouri.—The rare mineral leadhillite occurs near Granby, Mo., in part in good crystals associated with massive cerussite. As studied by Pirsson and Wells[5] these crystals are either prisms or plates having dimensions of one or more centimeters. The symmetry is monoclinic and pseudo-hexagonal, and the combinations are simple, usually (001), (110) and (100), more rarely also (201), ($\bar{4}$14) and ($\bar{4}$18). Twinning parallel to the unit prism is common and the basal cleavage is perfect. The physical and optical properties agree in the main with those of the already known leadhillite. The etched figures on the base (dilute nitric acid) closely resemble those of the micas. An analysis gave the following results:

SO_3	CO_2	PbO	H_2O	Total
7.33	8.14	82.44	1.68	99.59

The formula for the mineral is therefore Pb SO_4. 2Pb CO_3. Pb $(OH)_2$, which does not agree with any of the other published analyses of the mineral but is the formula which has been suggested by Groth.

Two New Instruments for Mineral Study.—Tutton[6] has published a brief preliminary notice of two important instruments which he has devised, full descriptions of which will be printed in the Philosophical Transactions. One of these is a delicate instrument for grinding very accurately in any desired direction, prisms and sections of minerals for optical study. In half an hour the two surfaces of the section may be prepared. The method is specially adapted to cut-

[5] Am. Jour. Sci., xlviii, pp. 219–226, Sept., 1894.

[6] Proc. Roy. Soc., lv, (1894), pp. 108–113.

ting the fragile crystals of artificial compounds. It is possible to grind and polish a truly plane surface in any desired direction accurate to within ten minutes of arc. The second device is likewise a somewhat elaborate one for securing monochromatic light of any desired wave-length. This apparatus, which is specially adapted to axial angle instruments, goniometers, spectrometers, stauroscopes and microscopes, secures for the whole field even and bright illumination by monochromatic light of any desired wave-length.

Miscellaneous Notes.—Moses[7] describes a simplified method of obtaining the projection of the crystallographic axes in clinographic projections of crystals.—Luquer[8] gives in concise form, characters for the optical recognition of the common minerals found in building stones. The form is a convenient one for use, but some quite misleading statements are included, such as the differentiation of quartz from nephelene and apatite "by absence of hexagonal crystals." Apatite and orthoclase are both said to have low relief.—George Otis Smith[9] describes two very large scapolites from Eel Lake, six miles from Kingston, Ontario, on which the third order pyramid $(\frac{3P3}{2})$ (131) is developed at both ends of the crystals. The larger crystal exhibits all the known forms of scapolite except the base. Smith in the same paper examines the monster gypsum crystals of the South Wash, Utah, and a prism thought to be one described by Moses[10] as a new form (450), is found to be the known form (340).—Penfield and Kreider[11] show that hydrofranklinite and chalcophanite are identical. Hydrofranklinite is not isometric as supposed by Roepper, but rhombohedral, the combination shown in the crystals being rhombohedron and base.

Penfield[12] has found a crystal of octahedrite among brookites from Magnet Cove, Ark. Penfieldite[13] is described in detail. The mineral has holohedral hexagonal symmetry, distinct basal cleavage, and strong, positive double refraction. A study is made of the cleavage of albite and oligoclase[14] in which it is shown that the oligoclase from Bakersville, N. C., exhibits two varieties; the one twinned polysynthetically accord-

[7] School of Mines Quarterly, xv, pp. 214–218.
[8] Ibidem, pp. 285–336.
[9] Johns Hopkins Univ. Circulars, No. 112, May, 1894.
[10] School of Mines Quaterly, xiv, p. 325; Science, xxi, p. 230.
[11] Am. Jour. Sci., xlviii, pp. 141–143. Aug,, 1894.
[12] Am. Jour. Sci., xlviii, pp. 113-118, August, 1894.
[13] Penfield, ibidem.
[14] Penfield, ibidem.

ing to the albite law and cleaving well parallel to (010), the other being without twinning or brachy-pinacoidal cleavage, but separating well parallel to $(12\bar{1})$. This suggests that the common cleaving of plagioclase parallel to (010) may be only parting. In an albite from Amelia County, Va., a few parting planes parallel to *m* (110) and *o* $(11\bar{1})$ were observed. Lehmann's experiment of producing the prismatic parting in normal albite by throwing heated albite fragments into water, was repeated, but no tendency to develop the pyramidal parting under these circumstances was apparent. By holding in a vise and subjecting to a pressure in the direction of the *b* axis, both the partings (110) and $(\bar{1}11)$ were produced in the Amelia albite. Hurlburt[15] describes alunite filling pockets and seams in the ore body at the National Belle mine at Red Mountain, Ouray County, Col. Analysis furnished the following results:

SO_3	Al_2O_3	K_2O	Na_2O	H_2O	Insol.	Total
38.93	39.03	4.26	4.41	13.35	.50	100.48

This furnishes the formula $(K\ Na)\ (Al\ [OH]_2)_3\ (SO_4)_2$, sodium and potassium being present in the proportions 4 : 7 as in the alunite described by Cross from the Rosita Hills.[16]—Cerussite is described by Pratt[17] from the Judge Mine, Black Hawk, Meager County, Mont., in crystals having the forms *b* (010), *c* (001), *m* (110), *x* (012), *v* (031), *i* (021) and *p* (111). In the same paper are described the zircons from the nepheline syenite of Dungannan and Farady, Ont. These are sometimes so distorted as to resemble the combination of a flat rhombohedron with a second order prism. Other crystals are almost ideally developed and exhibit the forms *p* (111), *a* (100), *m* (110) and *v* (221).—Ingersoll[18] describes hemimorphic wulfenite crystals from the turquoise mines in the Jarilla Mts., N. M. The hemimorphic character is indicated by the general habit and by the occurrence of the second order pyramid $(20\bar{1})$ only in the lower portion of the crystal. The pyramidal hemihedrism is indicated by the occurrence of the pyramid of the third order, π (313).

[15] Am. Jour. Sci., xlviii, pp. 130–131.
[16] Am. Jour. Sci., xlviii, p. 466, 1891.
[17] Ibidem, xlviii, pp. 212–215. Sept., 1894.
[18] Ibidem, pp. 193–195.

PETROGRAPHY.[1]

The Serpentines of San Francisco.—The serpentine of the Protero, a district within the limits of the city of San Francisco, is an eruptive rock intrusive in sandstone. It was originally a lherzolite, which by the usual processes of alteration has been changed to serpentine. Two varieties of the rock are noticed by Palache.[2] One is a massive form, while the other is slickensided along so many planes close together that the rock has became schistose. Between the slickensided surfaces are often spheroidal masses of the massive rock. The massive serpentine is of the usual character. It consists now of a felt of serpentine fibres in which are imbedded numerous crystal-like areas of enstatite and diallage, and grains of olivine, magnetite and chromite. The crystal-like particles of the pyroxenes are remnants of larger grains that were shattered by dynamic action. The pyroxenes and the olivine have yielded the serpentine. Intrusive into the serpentine is a hypersthene diabase, composed of labradorite, monoclinic and orthorhombic pyroxenes and green hornblende, supposed to be derived from the pyroxene. Its structure is ophitic. A second variety of the rock consists essentially of plagioclase and hornblende. Portions of it are schistose. Its structure is sometimes granitic and sometimes ophitic, and in the latter case it contains small quantities of pyroxene. Hence it is regarded as an altered form of the diabase. An analysis of the hornblende variety follows:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	TiO_2	H_2O	Total
47.41	16.03	2.66	7.05	tr	12.33	5.81		4.47	tr	1.29	2.19	=99.24

Density = 2.96.

The Blue Hornblende in the California Schists.—In many of the schists of the Coast Range, Cal., is a blue amphibole that has for some years past gone under the name of glaucophane. Palache[3] has recently found it in large quantities and in well developed columnar crystals in a schist-boulder near Berkely. The matrix of the schist is a granular aggregate of clear, fresh albite, containing numerous liquid and solid inclusions. The latter consist largely of small grains

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Bull. Geol. Dept. Univ. of Cal., Vol. 1, p. 161.

[3] Ib., Vol. 1, p. 181.

and needles of the blue amphibole. In addition to these are tiny crystals of magnetite, sphene and zircon. In this matrix lie sheaves of the blue amphibole, which are formed of small needles or of large columnar crystals, sometimes measuring as much as 20 mm. in length. The crystals are well developed in the prismatic zone, where they exhibit clearly the cross section of amphibole. The plane of their optical axes is the clinopinacoid. The extinction of the mineral is about 13° to *c*, along the axis of greatest elasticity. The mineral must be closely related to riebeckite. A characteristic feature of the new amphibole is its strong pleochoism, which is stronger even than that of glaucophane. A=sky blue to dark blue; B=reddish to purplish-violet; C=yellowish-brown to greenish-yellow. When broken, crystals of the blue amphibole are often healed with green actinolite, and often fibres of the latter mineral unite portions of blue crystals on opposite sides of veins of albite cutting through the rock mass. An analysis of the blue mineral gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	Total
55.02	4.75	10.91	9.46	tr	9.30	2.38	7.62	.27	undet.	= 99.70

This indicates a mixture of the three molecules $Na_2 Al_2 Si_4O_{12}$, $Na_2 Fe_2''' Si_4O_{12}$ and $R''SiO_3$ (where R is Mg : Ee : Ca = 6 : 2 : 1) in the proportions 1 : 2 : 9. The optical properties of the mineral are very similar to those of the blue amphibole described by Cross.[4] Chemically, it lies between riebeckite and glaucophane. The author names it crossite.

The Diorites, Gabbros and Amphibolites of Argentina.—The basic rocks from Argentine in the collection of Berlin University have been studied petrographically by Romberg.[5] They occur in the easternmost of the Cordilleran chains, associated with crystalline schists and eruptive rocks. The diorites and gabbros form stocks, and sometimes sills and dykes, that are closely associated with gneiss and crystalline limestones. The author divides the rocks studied into a number of groups and sub-groups, recognizing as the two principal groups eruptive rocks, and those associated with the crystalline schists. Among the undoubled eruptives are gabbros and diorites, and of the latter class there are two varieties, the diorites proper and the quartz diorites. Gabbro-diorites are also recognized among the specimens. The gab-

[4] Cf. American Naturalist, 1890, p. 1073.

[5] Neues Jarb. f. Min. etc., B. B., ix, p. 293.

bros include olivinitic and non-olivinitic varieties. In the former there is often a bluish-green hornblende, at whose contact with feldspar there is often a fringe of spinel arranged in pseudopodia-like masses with their long directions perpendicular to the bounding surfaces of the amphibole. In other specimens the olivine is separated from feldspar by a band of hypersthene. Norites, with reaction-rims around their olivines, and peridotites containing enstatite are among the other members of the gabbro family met with. More closely associated with the schists than all the rocks just mentioned, and apparently forming a portion of the schist series, are diorites, often saussuritized, and amphibolites among the hornblende rocks, and gabbros, peridotites and serpentines among the pyroxene bearing kinds. The basic schistose rocks in the collection studied are schistose diorites, and rocks composed essentially of epidote and zoisite, and of garnet and scapolite, supposed to be derived from diorite, schistose gabbros and hornblende schists. After describing the characteristic features of the gabbro and diorite structures, the author proceeds to discuss the origin of the Argentine hornblende schists. He finds no evidence that these are squeezed plutonic rocks nor metamorphosed sediments, and so he concludes that they are submarine eruptives.

Amphiboles in Russian Rocks.—Federow[6] gives some interesting notes on the amphiboles in the rocks of the northern Urals. The mineral is frequently absent from the freshest rocks. It is most abundantly present in those that have been metamorphosed by pressure. The kinds observed were a yellow-green variety, a colorless or very light colored kind, a dark brown variety, a fibrous variety with a blue color, glaucophane and gastaldite. The first is especially common in gneiss, syenite and syenitic gneiss, and it is present also in a diabase, where it is believed to have been derived from chlorite. The second variety is common to highly metamorphic rocks, while the third is limited to diabases and proterobases. The fourth variety is characteristic of the green schists, more particularly those that have undergone chemical alterations. The glaucophane is found in magnetite schists, in a few altered green schists and in gneiss. The sixth variety is also common to the green schists. In a syenite gneiss the author observed a brown augite that along a zone of crushing has been changed to a light green pyroxene, which is regarded as evidence that dark brown amphibole may give rise by pressure to light green hornblende.

[6] Minn. u. Petrog. Mitth., xiv, p. 143.

Basalt Boulders from Thetford, Vt.—A brief description of the material of the peculiar basalt boulders discovered by Hubbard at Thetford, Vt., is given by Hovey[7] in a recent paper. The most conspicuous features of the boulders are the large masses of olivine and pyroxene scattered through them. The former are in rounded aggregates with a granular structure. Their composition is $SiO_2 = 40.75$, $FeO = 9.36$; $MgO = 50.28$. The pyroxene nodules consist of the remnants of single crystals of a pale green color, and with an extinction of 44°. These nodules are in a groundmass composed of augite, plagioclase, hornblende and several accessory substances. The augite of the groundmass is brownish-violet in color, and it has the peculiarities of basaltic augite.

Maryland Granites.—Keyes[8] argues the original character of much of the epidote in Maryland granites from its close association with allanite, which is believed to be an original component of the rocks, since it occurs in them as sharply defined crystals completely mantled by fresh biotite. It is found also included in crystals of sphene of whose primary nature there can be no doubt. Finally its grains are idiomorphic with respect to many of the original rock components with which they are in contact.

[7] Trans. N. Y. Acad. Sciences, xiii, p. 161.
[8] Bull. Geol. Soc. Amer., Vol. 4, p. 305.

GEOGRAPHY AND TRAVELS.

Zoological Explorations in the Far North.—There is rejoicing at the State University of Iowa over the safe return of Mr. Frank Russell, after two and a half years' absence in the far north, where he has been engaged in zoological explorations.

Mr. Russell undertook to secure series of specimens of the larger mammals, besides birds, ethnological material, etc., from the less accessible parts of North America embraced in the region between Lake Winnipeg and the Arctic Coast. His explorations were made under the auspices of the State University of Iowa, from which institution he graduated in 1892.

Arriving in August, of 1892, at the mouth of the Saskatchewan River, on the northwest shore of Lake Winnipeg, he spent the first winter in securing series of moose, northern hare, ptarmigan, etc., and also became accustomed to the management of dog-sleds and snow-shoes, thus securing the necessary training and experience for the more serious work of the succeeding year. Voluminous notes were taken of the fauna of the region, and much information secured concerning the folk-lore and religious customs of the Swampy Cree Indians.

In February, of that year, Mr. Russell traversed the length of Lake Winnipeg, some three hundred miles, on snow-shoes, experiencing some of the coldest weather met with during his entire trip. From Winnipeg he went to Fort McLeod, near the foot-hills of the Rocky Mountains, just north of the boundary line, where six weeks were spent in collecting mammals and birds. Returning by rail to Edmonton, he traveled overland to Athabasca Landing and then descended the Athabasca River in a York-boat, with some officers of the Hudson Bay Company, reaching Fort Chippewyan, on Lake Athabasca, May 15th. A month was spent on the shores of the lake in securing a series of the birds of that region, the collector camping out alone during the entire time, living in a little "A" tent, and seeing but one man—a Cree Indian.

Early in July, our explorer proceeded down the Slave River to Great Slave Lake, reaching Fort Rae, on the northwest extension of the lake, early in August. This point was his base of operations until May of the succeeding year. During his various hunting trips from this center, he explored the vast and little-known territory around the Great Slave Lake, in some cases reaching points at least four hundred

miles from the Fort. During the winter, he traveled between twenty-one and twenty-two hundred miles on snow-shoes, driving his own dog-team and living, in almost all respects, the life of an Indian. He found it necessary to depend on himself alone, the natives being entirely unreliable. His more important excursions from Fort Rae were as follows:

A trip up the Yellow-Knife River to learn, if possible, something of the summer fauna of Barren Ground, and to secure the services of an Indian who had been recommended as trustworthy, but proved more of a hindrance than an aid.

Next, about five hundred miles were traveled in hunting for the Barren Ground caribou. A sufficient number were killed to secure a large supply of meat, and eleven skins and skulls of selected specimens were added to the collection, which has since arrived safely at Iowa City.

In midwinter, December and January, a long and arduous trip was taken in the hope of securing specimens of the wood buffalo, a variety of the American buffalo which still inhabits the region lying to the south and southwest of the Great Slave Lake. During this trip, Mr. Russell swung around a circle in which the whole of the Great Slave Lake was included, and also the territory for one hundred miles or more to the southwest. No wood buffalo were seen, nor even traces of them, although the very heart of their supposed range was traversed. Mr. Russell heard that two specimens had been killed that winter by the Indians, but they were apparently all that had been seen. He considers the race as almost exterminated, as their range is reported, by the Indian hunters, as very limited.

During March and April our explorer accomplished the main purpose for which he went north, *i. e.*, the capture of a series of musk-ox. The difficulties overcome at this time were such as to demonstrate the fact that Mr. Russell must take rank among the very foremost of plucky and persevering explorers in the far north. The musk-ox were four hundred miles from Fort Rae and two hundred miles from the edge of the woods. The Indians were unwilling to aid the explorer, having a firm belief that if a musk-ox were taken from the Barren Ground, and mounted in some distant country, all the others would go to join it. Those who have had to do with Indian superstition know the hopelessness of arguments, bribes or threats in such cases. Undismayed by this unforseen and seemingly fatal obstacle, Mr. Russell allowed the Indians to depart without him, well knowing that it is their custom to camp on the edge of the Barren Ground for some time for the purpose of killing caribou before going on the long musk-ox hunt, and know-

ing also that they would get out of ammunition and send a man two hundred miles back to the Fort for a new supply. When this messenger made his appearance as expected, Mr. Russell announced his determination to accompany him back to the Barren Ground, *nolens volens*. He persuaded him to make the best of the inevitable and accept pay for the enforced service. This was finally agreed to. Mr. Russell joined a band of the Indians at the edge of the Barren Ground, and accompanied them, driving his own dog-team and running behind the loaded sled until the "Musk-Ox Hills," two hundred miles distant on the treeless Barren Ground, were reached. These "Hills," by the way, he found to be mountains, several thousand feet high, and not far from Bathurst Inlet. The band of Indians separated into two squads, and succeeded in killing about one hundred of the musk-ox, including every one that was seen. The animals were found in comparatively small herds, rounded up by the dogs and mercilessly slaughtered. Mr. Russell killed four that had escaped from the main group as they were running off, and several others at another time. He was allowed five skins by the Indians, although he had killed a much larger number with his Winchester. These were all superb specimens—four males and a female, and, with the heavy horns and massive skulls, they made a sled load of such dimensions that the dog-team, although the strongest of the lot, became so weak before the woods were reached that Mr. Russell had to aid them almost constantly by pushing the sled from behind. Twenty-two days, in all, were passed on the Barren Ground. The explorer thought that about one thousand musk-ox were killed that season by the various bands of Indians who enter the Barren Ground from the south. The Esquimaux also penetrate the same region from the Arctic Coast, and, on one occasion, the Indians and Esquimaux have met. It is therefore evident that the musk-ox of the Barren Ground is doomed to follow the bison of the Plains, and join the rapidly growing list of "mammals recently exterminated."

On May 10th, Mr. Russell left Fort Rae, where he had received the kindest treatment and invaluable aid from the Hudson Bay officer in charge, Mr. Hodgson, and proceeded around the north shore of Great Slave Lake to Fort Providence, which he reached after unusual suffering from hunger and exposure. He found that the north shore of the lake was very inaccurately represented on the maps. At this time he was compelled to leave his faithful dogs with the Indians, although he exceedingly regretted the necessity. On May 25th, he succeeded in reaching a steamer, which had wintered about twenty miles below Fort Providence on the Mackenzie River, and proceeded down as far as

Fort Good Hope, which is almost exactly under the Arctic Circle. From here he paddled alone in a small canoe to Fort McPherson, two hundred and eighty miles farther north. Here he was joined by the celebrated French explorer, Count de Sainville, with whom he kept company for the remainder of his trip. While going to the mouth of the Mackenzie, some hundred and sixty miles below, he killed a grizzly bear as it was swimming the river. From the mouth of the Mackenzie he paddled his canoe through the ice-floes in the Arctic Sea to Herschel Island, a distance of one hundred miles, this being, in all probability, the first time a one-man canoe has ever gone over these waters. Several American whaling vessels had passed the previous winter at Herschel Island, and left two days after Mr. Russel reached that point. He made arrangements with Captain Newth, of the steam-whaler "Jeanette," for transportation to San Francisco, at the end of the whaling season. Two months were spent in making ornithological and ethnological collections on this island and the adjacent mainland, a remarkably fine series being secured.

August 30th, the "Jeanette" returned to Herschel Island and took on board Mr. Russell and his collections. The vessel then sailed to the region north of Wrangel Land, and here the passenger had the pleasure of seeing the process of killing and cutting up a large whale. Turning southward, the "Jeanette" touched at two points on the Siberian Coast, where Mr. Russell secured a monster Polar bear skin and skull, numerous ethnological specimens, and a unique collection of Esquimaux ivory work, graved, etched and colored, besides a pair of enormous walrus tusks. After a very rough voyage, the vessel entered the Golden Gate on October 27th, bearing the two passengers who had been the first men to traverse the vast length of the Athabasca, Slave and Mackenzie basins to the coast, returning to civilization by way of the Arctic Sea, Behring Straits and California.

Mr. Russell's collections have all been received in excellent condition, and constitute probably the finest series of zoological and ethnological specimens which have thus far been brought from the far north by any one explorer.

C. C. NUTTING.

BOTANY.[1]

The Wild Flowers of America.[2]—When Dr. Goodale and Isaac Sprague gave to the world, a dozen or more years ago, their magnificent work entitled the "Wild Flowers of America" no one then supposed that within a few years the title would be disgraced by such a work as we have now before us. In spite of the extravagant claims upon the title page, as to the "special artists and botanists" who are said to have prepared it, and the "leading artists of America and Europe who are said to have approved it, as well as the "university botanists of both continents" whose "endorsement" is alleged, we venture to affirm that no one with any artistic ability whatever, or even the slightest knowledge of the science of botany, could "approve" or "endorse" the hideously inartistic monstrosities here gathered together. We are not told who the "special artists" are, nor is the identity of the "botanists" revealed to us, but the publishers assure us that these unknown persons gave "years of unwearied toil, careful research and immense expenditure" to the gathering of the material! The publishers further state that the work was originally intended for "public institutions, universities and laboratories," but that "at the solicitation of some of the principal educators of the country" they have brought out an edition on "a popular basis." They speak of its "enormous educational value," and urge that school teachers and school children should be supplied with it. Finally, they connect the name of the American Association for the Advancement of Science with the work in a most unwarranted way.

Now what is the work so loudly praised by its publishers? It is a collection of very poorly drawn pictures of flowers, very badly colored. They have no botanical value, and to the non-botanical they are misleading, both in form and color. When one attempts to read the so-called descriptions, the extreme illiteracy of the author is as evident to the ear as the lack of artistic ability in the "artists" was plain to the eye. There is nothing like it anywhere. It is positively the worst piece of work all around that we have ever seen offered to the American people.—CHARLES E. BESSEY.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

[2] Botanical Fine Art Weekly.—Wild Flowers of America, published by G. H. Buek & Co, New York. Flowers of every state in the American Union, by a corps of special artists and botanists. Approved by the leading artists of America and Europe, and endorsed by university botanists of both continents.

Willis' Practical Flora.[3]—We are told in the preface of this well printed, and rather attractive book that "to engage the interest and enthusiasm of such students [elsewhere stated to be those without a scientific mind] it is necessary to show the practical aspects of the vegetable world, and its relations to the needs of everyday life," etc., and that there has been a long felt want for a work of such practical character, and this book has been prepared to meet the demand." This assigns the work to a peculiar class, and practically takes it out of the domain of scientific botany. If other teachers find it necessary to use devices such as the author suggests in his preface, perhaps no one but the friends of the unfortunate pupils need make objection. It may be well to say here, however, that such matter as is here presented is not botany, at any rate not the botany of this last decade of the nineteenth century. On looking over it one is carried back fifty years or more to the time when botany was little more than the handmaid of materia medica, horticulture and agriculture. Instead of bringing out a new book, the author has given to the American public a very old kind of book, including a very old kind of botany. Possibly in some of the ultra "practical" agricultural schools of the country it may supply "a long felt want," but it is scarcely probable that it will find a place in schools in which any pretence is made of teaching the *science* of botany.

Passing to details, one is puzzled to make out the principle upon which the plants described were selected. We find ten species of *Anemone* (all wild), nineteen of *Ranunculus* (sixteen wild), six of *Clematis* (wild), etc., etc., and yet there are no Water Lilies, Basswoods (*Tilia*), Rue, Hollies or Virginia Creepers. Yet, seven species of *Rhus* are given, in spite of the fact that but one Maple (the Sugar Maple) is given. The student might well ask also why the author omitted from the species of *Prunus* all mention of *P. americana*, the more commonly cultivated plum in the central United States. The cactuses are unnoticed, while of coffee (*Coffea*) thirty-five "species"! But five genera of *Compositæ* are given, viz.: *Inula*, *Anthemis*, *Chrysanthemum*, *Tanacetum* and *Carthamus*. Not a word is said about Asters, or Golden Rods, Dahlias or Thistles, nor is there anything about Artichokes, or Arnica even. The Olive is described, but not the Ash

[3] A Practical Flora for Schools and Colleges, by Oliver R. Willis, A. M., Ph. D., Instructor in Botany, Physics and Chemistry in the New York Military Academy. New York, Cincinnati, Chicago. American Book Company [1894]. pp. xvi, 349, 8vo.

trees, yet we find the Tomato, Tobacco, Pepper and Potato. It is odd, too, to say the least, that in a treatment of the Conifers which includes *Pinus monophylla* (which, by the way, the anthor confuses with other nut pines")no mention is made of *Pinus ponderosa*, *P. lambertiana* or *Pseudotsuga taxifolia*. Of the illustrations little need be said, more than that many of them are "trade cuts" from the catalogues of seedsmen, many of them possessing the characteristic exaggeration of such cuts. The figure of Indian Corn on page 287, with *fourteen ears*, will not tend to give one confidence in the truthfulness of the illustrations. —CHARLES E. BESSEY.

ZOOLOGY.

The Sensory Canal System of Chondrosteans—Collinge has studied especially Polydon, Psephurus and Acipenser. He cannot assent to naming every branch a canal but prefers to consider sensory organs, pits, pores, canals, etc., as parts of one sensory canal system. In this we have to distinguish the canals, the parts of which are named. The term cluster pores (=peripheral organs of allis) is given to the pores of fine dermal canals running from the main canals or branches; the pinhole pores of many authors are called primitive pores from the fact that they occur on the most generalized forms. Unbranched canals radiating from certain centres on the head, and with an ampulla near the proximal end are called ampullary canals. All of the different kinds of sensory organs are grouped under that name. The system in Polyodon is described for the first time. It contains all the structures except the ampullary canals, which have not been found except in Elasmobranchs. The parts are described with some detail, as is also their innervation. In the matter of the cranial nerves many corrections and additions are made to Van Wijhe's well-known description, especially in regard to the ramus oticus of the trigeminal and the ramus mandibularis of the facial.

Psephurus agrees pretty well with Polyodon but Acipenser is very different. The first two show marked Elasmobranch features while the latter has Teleostean tendencies. Collinge is inclined to support the validity of the group Ganoids and to accept its division into Selachioid and Teleostoid groups, the Acipenseridæ serving to connect the two. While the canal system in its broader features seems to confirm, in this respect, the evidence obtained from other organs, Collinge doubts if it can be employed in any except the most general manner.

The Hypophysis.—Lundborg has studied the hypophysis in teleosts and batrachians and concludes[1] that it arises as a paired structure from the deeper or nervous layer of the ectoderm, its two halves later fusing. At first there is an hypophysial stalk, short and solid, which later disappears. The future growth is one of folding, etc. The glandula infundibuli are later in arising from the infundibulum and a vertical communication always exists between infundibulum and gland.

[1] Zool. Jahrbücher, Abth. Anat. u. Ont., vii, 1894.

At first the gland consists of a single layer of round embryonic cells but it later becomes differentiated into two cell layers, the one of large capsular cells, the other of smaller triangular cells which lie between the apices of the others. Nothing new is given regarding the phylogeny of the organ.

The Species of Bothriocephalus.—From a recent article by R. Blanchard[2] the following key may be compiled as an index to the species of the collective genus *Bothriocephalus*:

1 { Genital organs single 2
  { Genital organs double 4

2 { Genital openings lateral (marginal), *Bothriotænia* Railliet, 1894.
  { Genital openings ventral or dorsal, ... 3

3 { Penis, vulva and uterus open ventro-median, . . . *Bothriocephalus* Bremser, 1819.
  { Penis and vulva ventro-median; uterus opens dorso-median, . *Ptychobothrium* Lönnberg, 1889.

4 { Penis, vulva an uterus open ventrally, *Krabbea* R.Bl., 1894.
  { Penis and vulva ventral; uterus opens dorsally, . . . *Diplogonoporus* Lönnberg, 1892.

Bothriotænia, type species *B. longicollis* (Molin), contains besides the type species, *B. fragilis*, *B. infundibuliformis*, *B. rugosus* and *B. suecicus*.

Bothriocephalus (type *B. latus*) contains *B. latus*, *B. cordatus* and *B. cristatus* found in man; a large number of species found in mammals, birds, reptiles and fishes.

Ptychobothrium contains *Pt. belonis*, *claviceps* and *punctatus* found in fishes.

Krabbea is founded upon a large 10 m. tapeworm recently found by Ijima and Kurimoto (Journ. Coll. Sc., Tokyo, 1894, IV, pp 371–385, Pl. XVIII) and contains besides this type *Kr. fasciata*, *Kr. variabilis* and probably *Bothriocephalus tetrapterus* and *B. antarcticus*.

Diplogonoporus Lönnberg, 1892 (=*Amphitretus* R.Bl., 1894) contains *A. wagneri* (Monticelli) and *A. lonchinobothrius* (Monticelli). —C. W. Stiles, Washington, D. C.

Batrachia of Vincennes, Indiana.—The following list of the Urodela found in the vicinity of Vincennes, Ind., includes only such

[2]Notices sur les Parasites de l'Homme: iv, Sur le *Krabbea grandis*, et remarkes sur la classification des Bothriocéphalinés; Compt. rend. Soc. Biol, 1894, pp. 699–702.

as I have captured myself. I have often assisted in draining ponds and clearing swamps and have secured many specimens in that way. I have also been a laborer for many years in a sawmill and often find eggs, larvæ, and even adult animals in the cracks and hollows and under the bark of logs drawn into the mill from the Wabash. I have at various times kept, or attempted to keep almost all the animals named here in captivity.

Siren lacertina (Linn.). Has no local name, being rare. The only specimen I have found was taken in midwinter from the hollow of a log that was rather rotten and filled with mud. I kept it in a barrel partly filled with mud and water. Being neglected, this was frozen over and had to be transferred to the cellar. When it finally thawed out the Siren appeared in no ways injured, but uttered a whistling hiss when touched and ate scraps of meat voraciously. It would eat earthworms and putrid meat, and on one occasion ate a lizard. I once put two laths down in the barrel and on the next day found my pet squirming about on the cellar floor, demonstrating that it could climb a little. It spent most of its time buried in the mud and I rarely saw it without first digging it up. In the eight months that I kept it it made no perceptible growth, yet it ate readily whenever it was dug up and fed. My last experiment was feeding it rancid bacon which it ate with a relish, but it died that night and I concluded that the salt had killed it.

Cryptobranchus alleghaniensis (Daudin). Probably rare in this locality. The only one that I have seen was 17 inches long, of dark slate color. Its bite left severe scratches.

Necturus maculatus (Raf.). Our commonest salamander. It will eat any kind of animal food. I have read of their biting but could never induce them to do so. Their eggs, laid about the middle of July, are about the size of peas and are quite transparent, offering the best possible material for the study of batrachian embryology. I have found them with their gills missing, apparently bitten off, but have met with no explanation and have none to offer.

Amblystoma microstomum (Cope). Common in stagnant pools. A gentle little creature that likes to be scratched or stroked with a feather, and soon learns to take earthworms from the fingers. Its legs are apparently weak, yet it can climb out of an empty tub or bucket. I have seen the larvæ leave the water.

Amblystoma tigrinum (Green). Repulsive and bloated in appearance. Adults of livid blue-black color with back covered with yellow spots which blend upon the belly, almost covering the surface. I have

seen the newly hatched young, scarcely more than half an inch in length, feeding upon aquatic animals and even eating coleopterous insects with their hard wing cases.

Amblystoma punctatum (Linn.). Slate color, with a row of 7 or 8 yellow spots on each side of body and similar rows on the tail. I kept a female that ate larvæ and earthworms and grew to over 7 inches. She deposited a large number of eggs imbedded in a mass of rather hard jelly, but they did not hatch, not having been fertilized by the male. She swam with her tail alone, holding her legs motionless by her side. When not disturbed she spent much of her time floating on the surface of the water. Her tail was prehensile.

Amblystoma opacum (Gravenborst). A sluggish animal. I have never seen the adult enter the water.

Hemidactylium scutatum (Schlegel). Brown colored, and rough-skinned. I have seen small ones, but never any with gill slits and have never seen it in the water. Like *A. punctatum* it has a prehensile tail.

Plethodon cinereus (Green). Black-backed. Numerous in swampy ground.

Plethodon erythronotus. Straight red stripe on back. Quick and active. I have seen them climb the glass sides of a show case in which they were confined.

Plethodon glutinosus (Green). Wet, stony ground. Apparently terrestrial, though it is a good swimmer. The prehensile power of its tail is the most highly developed of all of our native Salamanders.

Spelerpes longicaudus (Green). It makes an entertaining pet, for it is beautiful and active, takes food readily and moves with an absurd series of wriggles and jerks. The only specimens I have seen were found under logs on the top of a hill, far from water. I kept them in a box of wet moss and they flourished, but some kept by a friend in a dry box, supplied with a little pan of water, soon died.

Spelerpes maculicaudus (Cope). Rare, found beneath overhanging rocks.

Spelerpes bilineatus (Green). They are active, are good climbers and can *jump.*

Diemyctylus viridescens (Raf.). Common, easily domesticated. Active all the year, even when their ponds are frozen over. They have prehensile tails.

Desmognathus fusca (Raf.). Some years ago they were common under stones in Kelso Creek, near Vincennes, but now, with better

drainage, that creek goes entirely dry in the summer and they are, I think, entirely extinct.—ANGUS GAINES.

List of Snakes Observed at Raleigh, N. C.—1. *Ancistrodon contortrix.* Copperhead. Rather common here in the wet meadows, although universally known and recognized as the "Highland Moccasin."

2. *Ancistrodon piscivorus.* Our only specimen of the "Cottonmouth" was killed on Neuse River in the summer of 1891, and in bulk was one of the largest snakes we ever killed here. The length was, I think, 40 inches, although I have unfortunately lost the data connected with it.

3. *Heterodon platyrhinus.* "Spreading Adder." Common; the black variety is quite rare.

4. *Ophibolus getulus.* "King Snake." Common; feeds largely and I think usually, on other snakes, even its own species. I forced one to disgorge a meadow mouse a few weeks ago, otherwise its record of snakes for food is unbroken in my experience. It is popularly supposed to be excessively venomous and is also alleged by some to have a sting in its tail which it uses when angry.

5. *Ophibolus doliatus.* Rather rare; the specimens we get here agree in color with vars. *syspilus* and *coccineus.*

6. *Ophibolus rhombomaculatus.* Rather rare. Feeds on rats and mice judging from the few stomachs examined. Large specimens have the markings very obscure, being nearly uniform in color above. Our largest recorded specimen measures 42 inches.

7. *Cemophora coccinea.* Rare.

8. *Bascanium constrictor,* the Black Snake, is quite common here and is the most courageous of our snakes, frequently standing its ground and fiercely striking at an intruder. It occasionally, at least, eats other snakes.

9. *Coluber obsoletus.* "Chicken Snake." Not very common. This is the snake most frequently found ascending trees here and so it presumably feeds more on birds than any other. It is also the largest (longest) of our snakes, our largest recorded specimen measuring 74 inches.

10. *Coluber guttatus.* Quite rare here, only two specimens so far collected.

11. *Cyclophis æstivus.* Quite common, particularly in bushes in the low grounds. For some unexplained reason it is popularly considered as extremely venomous.

12. *Diadophis punctatus.* Rather scarce. The few I have personally taken have usually been near the water.

13. *Natrix sipedon.* Our commonest and in bulk our largest snake. Commonly known as "Water Mocassin." We sometimes get specimens uniform dusky above, uniform reddish below.

14. *Regina leberis.* Rather rare. We kept a female this summer for some time, till at last she gave birth to 13 young ones from 7¼ to 8 inches long.

15. *Storeria occipitomaculata.* Rather rare.

16. *Storeria dekayi.* Quite common.

17. *Eutainia sirtalis.* Common. Eats frogs, toads and sometimes, at least, small snakes.

18. *Eutainia saurita.* Common. Lives on small frogs and salamanders to some extent.

19. *Haldea striatula.* Common.

20. *Virginia valeriæ.* Quite rare, only seven specimens taken so far.

21. *Carphophiops amœnus.* Common. This and the two preceding are found under logs in the woods and are also sometimes ploughed up.—C. S. Brimley.

An Abnormal Pes of Columba livia.—During the winter of 1893 I came across a half-bred fantail pigeon whose left pes (Fig. 3) showed a pentadactylous condition. The right pes (Fig. 4), though apparently normal, revealed on dissection, in addition to the free hallux metatarsal element, an extra free metatarsal-like element which was placed median to the hallux metatarsal (Fig. 2).

In the left pes (Fg. 1) there are instead of a normal hallux two separate claws, two parallel phalanges with free ends but fused in the middle region, the proximal free ends articulating with a bilobed metatarsal which is ankylosed to the median surface of the proximal half of the conjoint metatarsals.

In a left pes of a common pigeon given to me by Mr. G. S. Miller, Jr., there were instead of the hallux, two closely appressed clawed phalanges articulating with a metatarsal which was not ankylosed with the conjoint metatarsals. Between this metatarsal and the second digit was apparently a small sixth digit with a well developed phalanx and claw.

S. D. Judd, Peterboro, N. Y.

Explanation of Figures, Plate I (Columba livia).

Fig. 1. Ventral view of the skeleton of the left pes, XI.

Fig. 2. Ventral view of the skeleton of the right pes in part, XI.

FIG. 3. Ventral view of the left pes, XI.
FIG. 4. Ventral view of the right pes, XI.

Zoological News. INVERTEBRATA.—Students of American forms will find much of interest in Garstang's "Fuanistic Notes at Plymouth."[3] Especially interesting are the notes on the synonymy of the Medusæ, the existence of budding in the Lucernarians, and the notes on the floating fauna, as obtained in the skimming net.

ECHINODERMS.—After a zoological silence of several years, Prof. A. E. Verrill takes up the Starfishes and Brittle Stars, describing[4] some of the species obtained by the U. S. Fish Commission and revising some of the previously described forms. Two new sub-families, two new genera and 15 new species are characterized; some pertinent criticisms are made on some of Sladen's family characters and a consistent revision is given of the ossicles commonly called paxillæ and pseudopaxillæ.

WORMS.—Andrews describes[5] some abnormal annelids, in which the caudal extremity of the body is forked, supplementing a previous paper (this journal, p. 725, 1892). The ten cases described agree in that in all the main axis of the body and all appendages are duplicated. As to the cause of such monsters little definite can be said. It seems probable, however, that they may be produced from adults. After some remarks on regeneration, Dr. Andrews concludes that "here we may suppose that injuries and other external agents affect the regenerative tissue so that the same cells that else had formed one normal terminal now form two more or less separate ones."

CRUSTACEA.—C. D. Marsh describes[6] two new species of Diaptomus, one from Mississippi, the other from Wisconsin.

Mr. Edgar J. Allen has just published[7] three of the most careful pieces of work as yet done on the histology and physiology of the nervous system of the Crustacea. The work was carried out on the lobster by means of the Methelyne blue and the rapid Golgi methods. Among the points brought out are the recognition of these nerve ele-

[3] Journ. Biol. Assoc. United Kingkom, iii, 210, 1894.
[4] Proc. U. S. Nat. Mus., xvii, 245, 1894.
[5] Quarterly Jour. Micros. Sci., xxxvi, 435, 1894.
[6] Trans. Wisc. Acad. Sci. and Arts, x, 1894.
[7] Quar. Jour. Micros. Soc., xxxvi, 461, 1894.

ments: 1. Co-ordinating elements which lie entirely in the ganglionic chain. 2. Motor elements in which the ganglion cell is in the chain, the fibre running out at a lateral root. 3. Sensory elements, consisting of cells outside the chain and fibres running from them to the chain. The stomatogastric nerve is also studied and the beading of nerve fibres, etc., is discussed.

ARACHNIDA.—Emerton has gathered several collecctions of Canadian spiders and publishes[8] a list with annotations and descriptions of new species. The close similarity of the Canadian fauna with that of New England is noted. "Out of 61 species, from Labrador to Manitoba, 56 species live in New England; and out of 48 species from the Rocky Mountains, 27 have been found in New England."

HEXAPODA.—M. H. Wellman has studied the prothorax of Butterflies[9] and finds that four different types of structure, corresponding to the four recognized families, exist. In the first (Nymphalidæ) the chitinized dorsal lobes of the prothorax are large, almost filling the space between the head and mesothorax. In the second class (Papilionidæ) the dorsal lobes are smaller while the scutellum has increased in size. This class is capable of division into three groups. In the Lycænidæ, the third class, the prothorax is very narrow, and the parts inconspicuous. In the last (Hesperiidæ) the lobes are scale-like.

W. A. Snow publishes[10] a synopsis of the American Platypezidæ. This Dipterous family is rare in America, but in an expedition to New Mexico the University obtained seven species, six of which are regarded as new.

FISHES.—Eigenmann and Beeson publish[11] a revision of the Pacific coast species of the Sebastinæ. The outline of the classification adopted was published in this journal for July, 1893.

E. W. L. Holt continues[12] his North Sea investigations. The subjects treated are (I) the destruction of immature fish, especially of plaice, haddock, and cod. He shows that great injury is being done. (III) A differentiation of a new species of ray (*Raia blanda*). (IV)

[8] Trans. Conn. Acad. Science, ix, p. 400, 1894.
[9] Kansas Univ. Quarterly, iii, 137, 1894.
[10] Kansas Univ. Quarterly, iii, 143, 1893.
[11] Proc. U. S. Nat. Mus., xvii, 375.
[12] Jour. Biol. Association United Kingdom, iii, p. 169, 1894.

The recessus orbitalis, an accessory visual apparatus in flat fishes. This consists of a diverticulum of the orbital cavity, innervated by the facialis, and is supposed to play a part in the protraction and retraction of the eye. (V) A description of a sole with symmetrical eyes. (VI) The reproduction of the Scad (*Caranx trachurus*) which oviposits in May, the eggs being pelagic and containing an oil globule, the yolk being broken up into spherules. (VII) A dwarf variety of the Plaice in which it appears that the forms with ciliated scales are males, those with smooth scales females.

J. T. Cunningham describes[13] the young stages of *Zeugopterus punctatus* in which he discusses the relation of various Pleuronected young. He also describes the experiments carried on in the Plymouth laboratory in rearing fish larvæ.

Evermann has been studying the salmon fisheries of the Columbia River basin and clearly shows[14] that extensive damage has already been done by over fishing and especially by fishing throughout the whole of the run. The commissioner suggests the stoppage of fishing during September and October, by laws passed by all of the states interested. A valuable annotated list of all the fishes collected is given in which several new species are described.

BATRACHIA.—Grönberg and von Klinckowström publish[15] an account of the structure of the Surinam Toad, *Pipa americana*. Integument, including the pouches for the young, digestive, respiratory, urogenital, nervous and vascular systems are described.

REPTILIA.—As a result of an osteological investigation Baur concludes[16] that the genus Anniella must be placed in a separate family, very close to the Anguidæ, and has its closest relative in Anguis itself. Figures are promised in a forthcoming paper on the morphology of Amphisbænia.

Dr. Einar Lœnberg of the University of Upsala, spent nearly a year collecting in Florida. A list of Reptiles and Batrachians col-

[13] Jour. Biol. Assoc., iii, 202, 1894.

[14] Rept. Commiss. of Fish and Fisheries on Investigations in the Columbia River Basin, Washington, 1894.

[15] Zool. Jahrbücher. Abth. Anat., vii, 1894.

[16] Proc. U. S. Nat. Mus., xviii, 348, 1894.

lected has now been published.[17] No new species are described. The notes on the poisonous character of *Elaps fulvius* are interesting.

BIRDS.—Menke catalogues[18] the birds of Finney Co., Western Kansas. Three species are added to the fauna of the State: *Carpodacus frontalis, Piranga ludoviciana* and *Hesperocichla nævia.*

Ridgway describes[19] *Zosteropes aldabarensis, Z. gloriosæ, Cinnyris aldabarensis, C. abbotti, Centropus insularis* and *Caprimulgus aldabarensis,* from Islands of the Malagassy region. In the same volume[20] he adds twenty-two new species to the Avian fauna of the Galapagos Islands.

MAMMALS.—True describes[21] as new species of North American mammals, *Sciurus aberti concolor, Scapanus dilatus, Myodes nigripes* and *Mictomys* (n. g.) *innuitus. Parascalops* is a new genus proposed for *Scalops breweri.* The same author also describes[22] *Sminthus flavus* as new from Kashmir, and from North America[23] four new species of wood rats (Neotoma).

[17] Proc. U. S. Nat. Mus., xvii, 317, 1894.
[18] Kansas Univ. Quarterly, iii, 127, 1894.
[19] Proc. U. S. Nat. Mus., xvii, 371, 1894.
[20] t. c. p., 357.
[21] Proc. U. S. Nat. Mus., xvii, 241, 1894.
[22] tom. cit., p. 341.
[23] tom. cit., p. 353.

EMBRYOLOGY.[1]

Optimum Temperature for Incubation.—M. Féré contributes to the *Journal de l'Anatomie* for July, 1894, the results of some experiments upon hen's eggs incubated at 34°–41°. These seem to have been made with caution and to warrant the author's conclusion that 38° is the temperature at which the smallest number of abnormal developments take place, at least during the first few days of incubation.

By exposing eggs to fumes of alcohol the author finds also that the injurious effects are overcome afterwards, in a larger percentage of cases, if the eggs are incubated at this optimum temperature, 38°, than at any other.

Cell Lineage.—Mr. A. D. Mead has made a comparative study of the cleavage in the polychætous annelids, Amphitrite, Lepidonotus, Clymenella and Scolecolepsis, along the lines marked out by E. B. Wilson in his noted paper upon Nereis. From the preliminary results,[2] those who are especially interested in this group may gather much of importance regarding the exact fate of cells of equal origin in the different species.

It will be of general interest to compare the results, when published in full, with those obtained upon Nereis, for in spite of the resemblances that are so close in this group there seem to be some marked differences, in the axial relations especially. We note that the median plane of Amphitrite corresponds to a plane bisecting two of the first four cells in place of passing between two cells, right and left, as in Nereis.

Fertilization in the Earthworm.[3]—A preliminary account of what promises to be a most valuable contribution is the result of the detailed study of the eggs of the striped earthworm, Allolobophora *fœtida*. The author, Katherine Foot, has studied the processes of maturation and fertilization in some two hundred eggs taken from the cocoons in which they are laid.

It seems that the sperm grows very rapidly just before the eggs are laid, so that one sperm may more than double its length within two

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Journal of Morphology, ix, Sept., 1894.

[3] Journal of Morphology, ix, Sept., 1894.

hours. These sperms have a long head with a spine at its lip, a middle piece of some length and a long tail. They are found free in the cocoons for some ten minutes after laying and then penetrate the eggs. Several sperms may penetrate a single egg and all act alike in giving rise to peculiar conical areas of disturbance. These are more readily understood from the very interesting diagrammatic figures than from any verbal description. These figures seem to show much that the author does not emphasize regarding the minute protoplasmic phenomena concerned.

The egg gives off two polar bodies after the cocoon is deposited. The first divides into two; the three thus formed subsequently break up into spherical bodies that lie irregularly between the egg and its membrane, as many as ten being found by the time the pronuclei are formed. The number of chromosomes is eleven, in the first maturation spindle, in the first polar body, in the second maturation spindle, in the second polar body, and in the egg after this has been constricted off.

The pronuclei are usually only two and do not present discovered differences.

It is claimed that the nuclei are seen distributed through the cytoplasm of the egg during the formation of the first maturation spindle.

The remarkable structures known as "polar rings" in the eggs of Clepsine are recognized again in this earthworm as peculiar and dissimilar appearances seen at opposite poles when the pronuclei are formed.

Cleavage in Batrachia—A study of the phenomena that actually take place in the cleavage of Amblystoma, Diemyctylus, *Rana palustris*, and *Bufo variabilis* has led Messrs. Jordan and Eycleshymer[4] to views that militate against much of the definiteness regarding the cleavage process that still remains in the text books.

They find that "each egg, as a rule, possesses an individual rhythm of cell-division and the time intervals between the different sets of furrows are substantially the same in the same egg. There is, however, considerable variation between these rhythms in different eggs."

Great variations occur in the way and in the relative time that cells divide, that cleavage planes appear, in fact, they state—"we have found irregularity to be the rule, regularity the exception."

No importance can be attached to any agreement between the first plane of cleavage and the median plane of the resulting embryo, since,

[4]Idem.

owing to extensive torsions and cell shifting, material is brought from one side to the other.

Again, from these studies it seems evident that in these Bratachia there is no such definite cell homology to be traced as in the Annelids.

The tendency of the paper is decidedly iconoclastic; what new generalizations may be built up from such data remains for the future to reveal.

Development of Sponges.—An important but much delayed paper by H. V. Wilson has at length been published.[5]

The author studied the marine sponges, Esperella, Tedania and other genera, in the Bahamas and on the New England coast.

The main body of this monograph of one hundred pages and twelve plates is an account of the formation and metamorphosis of the "gemmules" in the above named sponges.

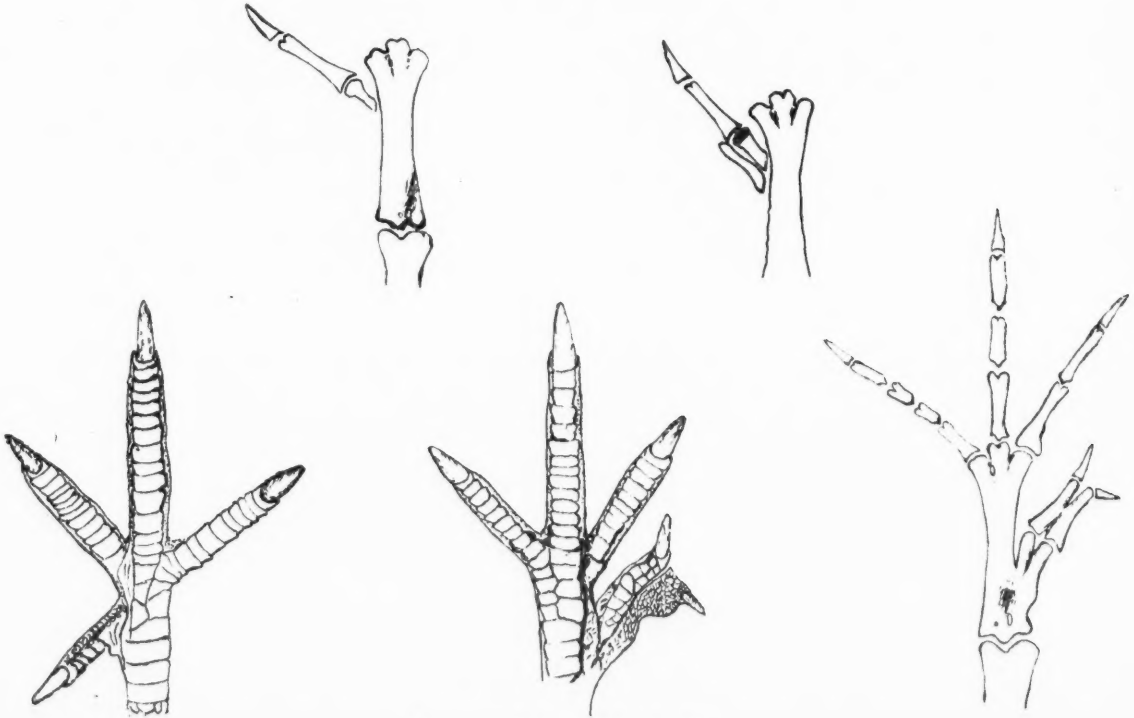
These gemmules in Esperella are masses of cells that contain yolk and may appear anywhere in the mesoderm; they are formed by a collecting of cells to make a central mass or gemmule surrounded by a follicle. As the cells multiply other small gemmules may be added on to make a compound mass that ultimately undergoes a process of separation into the component cells. A free swimming larva is formed by this mass of cells that then escapes from the mother tissue. The outermost cells form an ectodermal layer that is ciliated except at the posterior pole where the cells are flattened and not pigmented as are the ciliated cells. The inner cells are connected by processes and form a parenchyma mass.

This active larva attaches itself obliquely by the posterior pole and undergoes a metamorphosis in which the ectoderm changes into a layer of simple flat cells and the loose cells of the mesodermal parenchyma arrange themselves about inter-cellular spaces, that at first are all alike, but subsequently become the various sponge cavities, subdermal spaces, afferent and efferent canals. These spaces are at first independent and only later become connected. The flaggellated chambers also arise independent of one another and of the other spaces and by a similar process of cell arrangement about intercellular spaces.

These remarkable gemmules closely resemble larvæ derived from eggs and have "germ" layers and the same specialization of the posterior end as is found in the egg larva. This noteworthy resemblance, the author thinks is due to inheritance from a common source and that thus the non-sexual gemmule has retained ancestral traits. No other

[5] Journal of Morphology, ix, Sept., 1894.

PLATE VI.



Abnormal foot of *Columba livia*.

such case is known, unless it be the anomalous mode of hydroid formation in *Epenthesis McCradyi* as described by W. K. Brooks.

In an important discussion of the morphology of sponges, the author, basing his conceptions provisionally upon the generalizations of Haeckel and of Schultze, infers from the comparative anatomy of the group that there was a common ancestor, the Olynthus, which passed into the Sycon state by the outgrowth of radial tubes and this again into the Leucon by the growth of the radial tubes into flagellate chambers and by the growth of new entodermic diverticula. The non-calcareous have come from Leucon-like types. The afferent system of canals is ectodermic; the efferent entodermic.

In the embryology, on the other hand, many abbreviations and other coenogenetic changes have obscured the record of the past. The entoderm and mesoderm must be regarded as not as yet sharply differentiated from one another.

Both sponges and coelenterates probably had a common *solid* ancestor, the Parenchymella. The blastopore cannot be regarded as an ancestral mouth and so its position is not of much weight in deciding how far the cavities of sponges and coelenterates are homologous.

ENTOMOLOGY.[1]

Sight in Insects.—In his recent address as President of the Biological Society of Washington, Dr. C. V. Riley[2] said: "Of the five ordinary senses recognized in ourselves and most higher animals, insects have, beyond all doubt, the sense of sight, and there can be as little question that they possess the sense of touch, taste, smell and hearing. Yet, save, perhaps, that of touch, none of these senses, as possessed by insects, can be strictly compared with our own, while there is the best of evidence that insects possess other senses which we do not, and that they have sense organs with which we have none to compare. He who tries to comprehend the mechanism of our own senses —the manner in which the subtler sensations are conveyed to the brain—will realize how little we know thereof after all that has been written. It is not to be wondered at, therefore, that authors should differ as to the nature of many of the sense organs of insects, or that there should be little or no absolute knowledge of the manner in which the senses act upon them. The solution of psychical problems may never, indeed, be obtained, so infinitely minute are the ultimate atoms of matter; and those who have given most attention to the subject must echo the sentiment of Lubbock, that the principal impression which the more recent works on the intelligence and senses of animals leave on the mind is that we know very little, indeed, on the subject. We can but empirically observe and experiment and draw conclusions from well attested results.

Sight.—Taking first the sense of sight, much has been written as to the picture which the compound eye of insects produces upon the brain or upon the nerve centers. Most insects which undergo complete metamorphoses possess in their adolescent states simple eyes or ocelli, and sometimes groups of them of varying size and in varying situations. It is difficult, if not impossible, to demonstrate experimentally their efficiency as organs of sight; the probabilities are that they give but the faintest impressions, but otherwise act as do our own. The fact that they are possessed only by larvæ which are exposed more or less fully to the light, while those larvæ which are endophytous, or otherwise hidden from light, generally lack them, is in itself proof that they perform the ordinary functions of sight, however, low in degree. In

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Insect Life, VII, p. 33.

the imago state the great majority of insects have their simple eyes in addition to the compound eyes. In many cases, however, the former are more or less covered with vestiture, which is another evidence that their function is of a low order, and lends weight to the view that they are useful chiefly for near vision and in dark places. The compound eyes are prominent and adjustable in proportion as they are of service to the species, as witness those of the common house-fly and of the Libellulidæ or dragon flies. It is obvious from the structure of these compound eyes that impressions through them must be very different from those received through our own, and, in point of fact, the late experimental researches of Hickson, Plateau, Tocke and Lemmermann, Pankrath, Exner and Viallanes, practically established the fact, that while insects are shortsighted and perceive stationary objects imperfectly, yet their compound eyes are better fitted than the vertebrate eye for apprehending objects set in relief or in motion, and are likewise keenly sensitive to color.

So far as experiments have gone they show that insects have a keen color sense, though here again their sensations of color are different from those produced upon us. Thus, as Lubbock has shown, ants are very sensitive to the ultra violet rays of the spectrum, which we cannot perceive, though he was led to conclude that to the ant the general aspect of nature is presented in an aspect very different from that in which it appears to us. In reference to bees, the experiments of the same author prove clearly that they have this sense of color highly developed, as indeed might be expected when we consider the part they have played in the development of flowers. While these experiments seem to show that blue is the bee's favorite color, this does not accord with Albert Müller's experience in nature, nor with the general experience of apiarians, who, if asked, would very generally agree that bees show a preference for white flowers."

Origin of Reproductive Cells in Insects.—J. W. Tutt discussing the life history of a lepidopterous insect says of this subject :[3] "The earliest development of the ovum and spermatozoon in the embryo of insects is very obscure, but it would appear that the primitive ovaries are composed of a mass of cells, produced by an infolding of the ectoderm; but whilst some writers assert that they arise from the ectoderm, others consider them to be derived from the mesoderm, whilst still others trace their origin back to certain so-called pole cells, which originate even before the blastoderm is formed. However, this

[3] Entomologists Record, V, 246.

may be, it would appear, that they are in that early stage quite indistinguishable from other blastoderm cells.

"Therefore, it would appear, that whilst the great mass of cells become differentiated into various structures which subserve a special purpose, or perform their several functions, certain cells in the ovary retain their primitive condition, and with it the power, under suitable conditions, of forming another individual of the same species. On this subject Mr. Woodworth writes: 'About the time of the completion of the blastoderm, the already differentiated ventral plate infolds at a point on the median line about two-thirds from the upper end, and forms a very narrow pocket. The cells composing it look like the rest of the cells of the ventral plate at this time, they are almost round, and have a lining on one side made of the grey matter which originally bordered the whole egg, but which became a part of the blastoderm cells. The pocket remains open but a short time, but there is a long depresssion of the upper end of the bunch of cells; the mass of cells is soon cut off from the ventral plate and they are then free in the body cavity, but remain in contact with the ventral plate at the point where they were produced. Later stages show that these cells produce the generative organs; the generative organs thus appear to be produced by an infolding of the ectoderm, or possibly of the blastoderm, before the ectoderm is produced, but from a portion which is later to become ectoderm.'"

Alimentary Canal in Orthoptera.—Dr. F. Werner has compared[4] the relative length of the intestine in vegetarian and insectivorous Orthoptera. The result was unexpected. The plant-eating Acridiidæ have a short, almost straight gut, rarely larger than the body; while the Locustidæ have a longer gut usually spirally coiled, especially in Barbitistes and Phaneroptera. Werner believes that the length and coiling of the intestine have nothing to do with the diet, but are correlated with the shape of the body and the habits of life.—*Journal Royal Microscopical Society.*

North American Jassoidea.—Mr. Edward P. Van Duzee has published an excellent Catalogue of the Described Jassoidea of North America.[5] It covers more than fifty pages, and is especially full in bibliography and synonymy. "The classification and arrangement here adopted is substantially that proposed by the author in his 'Synop-

[4] Biolog. Centralbl., XIV, (1894), pp. 116-9.

[5] Trans. Am. Ent. Soc., XXI, July, 1894.

sis' published in these Transactions, Vol. XIX, pp. 296–300, December, 1892. The superfamily term there suggested includes those families in which the hind tibiæ are multispinose. These in our North American fauna are Ulopidæ, Ledridæ, Bythoscopidæ, Tettigoniidæ and Jassidæ. The first of these might perhaps be removed from this series, and the second united with the Tettigoniidæ as a subfamily of equal value with Gyponina and Tettigoniina. The position assigned to the family Bythoscopidæ is purely arbitrary, as it strictly parallels the Jassidæ, to which it is allied by Macropsis, and in a linear arrangement might with equal propriety follow the Tettigoniidæ."

The Use of Parasitic and Predaceous Insects.—There has recently been much discussion concerning the utilization of parasites and predaceous insects in destroying injurious species. A knowledge of the conditions under which such insects act would render it evident that we cannot hope to exterminate any species of noxious insect by means of its parasites alone; and many too sanguine expectations have been aroused. But, on the whole, parasitic and predaceous insects are of immense service to man. Without them many plant feeding species would multiply to such an extent that the production of certain crops would require vastly more effort than it does now. To say, as has been said, that parasitic and predaceous insects have no economic value, is to put the case too strongly. Take, for example, two crop pests of the first class—the army worm and the hessian fly. The history of a century shows that these insects fluctuate in numbers; that there are periods of immunity from their attacks followed by seasons when they are overwhelmingly abundant. It is universally acknowledged that in the case of the hessian fly, this periodicity is due almost entirely to the attacks of parasites, and in the case of the army worm to the attacks of parasites, predaceous enemies and infectious diseases. Remove these checks and what would be the result? The pests would keep up to the limits of their food supply and would necessitate the abandonment of the culture of the crops on which they feed. Take another case: Professor J. B. Smith has argued that "under ordinary conditions neither parasites nor predaceous insects advantage the farmer in the least," and to prove it he cites this instance: "Fifty per cent of the cutworms found in a field early in the season may prove to be infected with parasites, and none of the specimens so infested will ever change to moths that will reproduce their kind. Half of the entire brood has been practically destroyed and sometimes even a much larger proportion; but—and the 'but' deserves to be spelled with capitals—these cutworms will not be

destroyed until they have reached their full growth and have done all the damage to the farmer that they could have done had they not been parasitized at all. In other words, the fact that fifty per cent of the cutworms in his field are infested by parasites does not help the farmer in the least." But obviously it does help the farmer very greatly *the next season*, for it reduces by half the number of cutworms he will have to contend with. As a matter of fact cutworms fluctuate in numbers in a way quite similar to the army worm, and the fluctuations are largely due to parasitic enemies. I have seen regions where cutworms were so abundant that grain fields were literally cut off by them as by a mowing machine, and the following season the worms were so scarce as to do practically no damage. Even the plum curculio and the Colorado potato bettle are sometimes so scarce as to require no protection against them, and presumption is in favor of parasites as a cause of their scarcity.

But Professor Smith is right in saying that as a general rule there is too great a tendency to rely on natural enemies to subdue insect attack. It is nearly always safer to adopt effective measures in keeping pests in check than to trust to the chance of their natural enemies subduing them. As Dr. C. V. Riley has pointed out, "there are but two methods by which these insect friends of the farmer can be effectually utilized or encouraged, as for the most part they perform their work unseen and unheeded by him, and are practically beyond his control. These methods consist in the intelligent protection of those species which already exist in a given locality and in the introduction of desirable species which do not already exist there."

CLARENCE M. WEED.

Oviposition in Acridiidæ.—M. J. Künckel d'Herculais describes[6] the means by which these Orthoptera bury their abdomen in the ground; there is no perforation of the ground, the hinder part of the body is merely forced into it; as the Arabs say the female "plantent." On dissecting females whose abdomen had reached the maximum of distension, the author was surprised to find that the abdomen was filled with air; on the air being withdrawn, the abdomen was reduced from 8 to 5 cm. in length. When the position is firmly taken up the females of the migratory locust maintain the parts of their genital armor as widely separated as possible, and secrete a viscous material which agglutinates the grains of sand, or the particles of earth at the bottom of the cavity, and they then begin to lay their eggs. These

[6] Comptes Rendus, CXIX, 1894, pp. 244–7.

and the viscous material are emitted simultaneously, but the latter is peripheral and so consolidates the walls of the cavity which has the curved form of the abdomen. When the eggs are laid the viscous material continues to be shed, and on drying forms a stopper which protects the cavity.—*Journal Royal Microscopical Society.*

The Use of Chinch Bug Diseases.—In Bulletin No. 5 from the office of the State Entomologist of Illinois, Professor S. A. Forbes summarizes the results of years of careful experiment with the white muscardine disease of the Chinch Bug as follows:

1. The white muscardine will not spread among vigorous chinch bugs in the field in very dry weather to an extent to give this disease any practical value as a means of promptly arresting serious chinch bug injury under such conditions. It may be added that chinch bugs are usually vigorous in dry weather.

2. It is most likely to "catch" in low spots, where the soil is kept somewhat moist by dense vegetation, a mat of fallen herbage, or the like. Shocks of corn, especially when the crop is cut early, furnish excellent places for the development of this disease.

3. If decidedly wet weather follows upon its introduction, even after an interval of several weeks, it is likely to start up and take visible effect; but continuous rains, depressing the vital energies of the insect, are commonly requisite to its efficient action.

4. It is always so generally prevalent, in a more or less latent state, among the chinch bugs of Illinois, both north and south, that it is very likely to appear and spread, as if spontaneously, whenever conditions favorable to its development long prevail, whether it has been purposely introduced or not.

5. The time elapsing between the establishment of such favorable conditions and the full development of the disease among the chinch bugs of any locality, may possibly be shortened if the infection has previously been introduced by any artificial means.

6. Whatever weakens the insect favors its spread, as a rule. It is consequently much more likely to attack adults than young, especially spent males and females which have laid their eggs, and which are soon to die of old age; but it nevertheless often kills young of all ages. In agreement with the above, we have noticed that the fall generation of adults is less subject to it, other things being equal, than the generation which matures in midsummer. As this fall brood is to live or winter before laying its eggs, it contains no worn-out adults.

7. We have lately ascertained that it may destroy the *eggs* of the chinch bug, and as these are commonly laid where they are kept more or less moist, this fact contains a suggestion of increased usefulness and a valuable hint as to the best time for introducing the infection into the field.

8. The fungus producing this disease will not *start* to grow on dead chinch bugs, if we may judge from the results of several experiments made this summer. Wherever a dead chinch bug shows its presence, consequently, it has made its attack on the living insect.

9. The resistant power of healthy chinch bugs exposed to infection is well shown by the fact that thousands of bugs, young and old, have commonly lived for many days, and even for several weeks, moulting, maturing, copulating, and laying their eggs, when shut up in infection boxes which had been heavily stocked with fungus spores from dead insects and had been made in every way as favorable as possible to the development of the disease. The percentage of those that would succumb from day to day was often ridiculously small.

10. The growth of the fungus in such boxes is sometimes checked and the whole experiment brought to a standstill by the appearance in the boxes of minute mites (apparently brought in with the food supplied to the bugs), which multiply in the boxes and greedily devour the fungus of white muscardine as fast as it grows.

11. Comparative experiments with fungus spores from diseased chinch bugs and with those derived from artificial cultures on corn meal moistened with beef broth, show that the latter are nearly, if not quite, as efficient agents of infection as the former. We have used only cultivated spores one or two removes from the growth on the insect, and consequently are not prepared to say that continued cultivation on an inanimate medium might not finally diminish the virulence of the fungus parasite; but, on the other hand, we have no very good reason to suppose that this will prove to be the case. I have no doubt, however, that by a properly guarded procedure, these artificial cultures, which can easily be made in almost unlimited quantity, may be utilized for a dissemination of the spores of these insect diseases, with great advantage in convenience, expedition, and economy of operation.

From all our experimental work thus far completed, I draw the general conclusion that infection with the fungus of the white muscardine of the chinch bug is an uncertain measure, largely dependent for its practical value upon conditions beyond the influence of the experimenter, and whose occurrence or prevalence it is impossible for him to

foresee. It appears, on the other hand, to be so powerful an agency for the destruction of chinch bugs *en masse* when the weather favors its development and spread, and can be made by proper organization so inexpensive to the individual and the State, that it is well worthy of the most thoroughgoing scientific study and practical field experimentation.

PSYCHOLOGY.

The Burrowing Habits of Snakes.—In my snake enclosure I have kept a wooden box filled with loose cotton and crumpled paper, and having holes in its sides for the accommodation of the reptiles. Throughout the heated term the snakes spent a large part of their time in this box, but as the weather grew cooler they abandoned it and found new hiding places under their bath tub, or under loose boards, digging down as much as possible into the thin layer of earth which covered the floor of their enclosure. I then lined their box and covered it with cloth to make it warmer and they would occupy it in fine weather, but on stormy or frosty nights they would come out, crawl under it, and lie there torpid with cold.

It was evident that their instinct led them astray in this instance by prompting them to get as close to the ground as possible to avoid cold. One fine day when they were all in their box I took it out and put it down beside the garden walk, giving them their liberty that I might watch them seek their own winter quarters.

Some of the Eutæniæ burrowed beneath the mudsills of a shed and disappeared, while others found hiding places under the house and do not come out even on warm days. Of the water snakes, (*N. sipedon*), 7 in number, three have left me, but the others remain in the yard and have not yet found permanent homes for the winter. On fine days I see them darting about or basking in the sun beside a puddle which I have prepared for them. At night, or on cool days, they may be found coiled up under a water bucket or leaky rain barrel, but none of them re-enter their box. I have often been surprised at the amount of cold snakes of this species can endure.

One *Ophibolus getulus* searched about a little while and then crawled under an empty barrel beside the walk. A short time afterwards I tilted the barrel to see what he was doing and found that he was trying to make a burrow, but the ground was hard and it was slow work. Used to being watched he paid no attention to me but continued to scrape the ground with his rostral. When at length he had excavated a hole deep enough to hide his head he gave himself a rotary motion, turning half around then back again, boring the hole a little deeper and throwing out a little dirt with the projecting backs of his jaws. Sinking still deeper he would draw himself down, filling the hole tightly, and then drawing back a little would throw out fine dirt with

his scales and abdominal plates. At length he disappeared entirely, leaving a large handful of dry dirt on the surface and completely filling the burrow behind him with loose dirt. Another *O. getulus* burrowed out of sight in a garden bed, but the ground was loose and he did not throw back the dirt but seemed to press it aside, leaving his burrow open behind him.

I have seen the *Phyllophilophis æstivus* dig its burrows with its broad rostral, the *Heterodon platyrhinus* turn up the soil with its trihedral rostral with as much facility as a rooting pig, and have watched the *Carphophis amœna* working its way through loose ground like the earth worms on which it feeds, but the *O. getulus* digging in hard ground and throwing out the dirt behind it was an unexpected sight.—Angus Gaines.

Habits of Heterodon platyrhinus at Raleigh, N. C.—This snake which is quite common here, has a habit when interfered with of first flattening its head and body and violently hissing; more interference causes the snake to writhe about violently opening its jaws to the fullest extent, it then finally turns on its back and simulates death but still keeps its mouth wide open. After "dying" it becomes perfectly limp and may be carried in the hand a mile or more without showing signs of life, usually, however, still keeping the mouth open. One peculiarity alone shows life; if placed on the ground belly down, it at once turns on its back again nor can it be persuaded, however, "dead", to lie on its belly.

This snake, although perfectly well-known to every one here, seems to be frequently confounded with the copperhead; only two months ago a colored boy came to us to find a remedy for snake bite as he had been bitten (as his badly swollen hand attested) by a "Spreading Add."

Another snake also confounded with the Spreading Adder is *Natrix sipedon*, on account of the habit sometimes indulged in by the latter species, particularly by young specimens, of flattening the body in a manner similar to that of *Heterodon*.

The favorite food of *Heterodon platyrhinus* in this locality is the common toad, and they will sometimes take as many as three at a meal. If interfered with after a meal they frequently disgorge one or more toads. Personally I have never known them to eat anything else, but a friend who kept one for sometime said it would also eat young specimens of its own species.

The wholly black variety of this species is very rare here, so far I have only seen three specimens.—C. S. Brimley.

ARCHEOLOGY AND ETHNOLOGY.[1]

Certain Sand Mounds of the St. John's River, Florida, by Clarence B. Moore.—The mounds of North America are documents which, to be read, must be destroyed, and the only excuse for their destroyer is that he has translated their meaning. If he has not —if he has not scrupulously recorded the depth and tint of each superposed layer and the position of each human trace, if he has not even gone farther and chronicled, for the sake of the future questioner, things that he sees no reason for chronicling, so much the worse for science. If, on the other hand, interested not in relics, but their meaning, he has carefully transcribed the facts observed he deserves the sincerest thanks of the student. These should be given to Mr. Clarence B. Moore, for his recent exploration of mounds and shell heaps in Florida. His book (Certain Sand Mounds of the St. John's River, Florida), is on the one hand an encouraging lesson to the investigator, while on the other it is a silent protest against much of the "relic hunting" that goes by the name of exploration. Each chapter condemns by inference, the treasure of the collecting enthusiast who, for the sake of his card boarded specimens, obliterates the pages of the book no less hopelessly than did Spanish priests when they threw Mayo Codices into the fire, and the value of specimens with a record, against the cheapness of those without one, increases as we read.

An account of 75 mounds of shell and sand faithfully explored by Mr. Moore on the St. John's River, Florida, catches the attention of the student at once, and he looks with particular interest for the result. What does it all mean? What have these painstaking labellings of specimens, fresh from the earth, these reiterated measurements, detailed minutiae, and laborious analyses, to tell us of the story of man? Are some explored sites older than others, so that we can prove a series of epochs in time? Do older sites yield a different class of remains from the younger, so that we may infer a sequence in culture, and suppose that the maker of mounds had a predecessor in Florida or, at least, developed there through a lower stage of culture into a higher? How long ago was it? Indians still live in Florida. Were these mound-makers' Indians? The white man came in the sixteenth century—which mounds were built before, which after, his coming? Which Indian arts were derived from him, and which preceeded his suggestion?

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

Mr. Moore's results bearing upon some of these questions might be summed up thus:

(a) THE FLORIDA MOUNDS LIKE OTHER MOUNDS.

The Floridan builders of sand mounds and shell heaps were like other pre-Columbian mound building tribes known to archaeology. They had certain peculiar customs, such as nicking arrow-head outlines from pottery (Mulberry Mound and Tick Island) to bury with the dead, depositing great numbers of Fulgur shells in mounds (1307 from one trench in Mount Royal), and cutting out fragments of pottery with sharp instruments to inter in graves, but neither these facts nor the scattered charcoal and random hearths of the mounds, the catlinite, the cache of 53 arrow-heads (Mount Royal), the sheets of mica (Tick Island and Mt. Royal), the perforated mussel pearls, the stone tube (Bluffton) or the gouge (Mount Royal), could disconnect these tumuli from the life and habits of the Indian as the white man knows him. The mound-makers cached an extraordinary batch of little baked earthen shapes in Volusia Mound mimicking the bear, turtle, puma, wildcat, tapir, possibly; the bud of the water-lily, the acorn, gourd, and ear of maize, but there was nothing in the ornamented fragment of human skull (Bluffton), the sharpened fragment of human bone (Tick Island), the copper-sheeted animal jaw (Tick Island), the bits of Galena (Mt. Royal), or the copper (Mt. Royal) to set aside these structures as a class unique in themselves or apart from other mounds in the United States.

Like the Indians of Maine, the Floridians spread layers of hematite reddened sand near interred human bones (Mount Royal) or with deposited relics (Grant's Mound at Dunn's Creek). Some mounds, levelled to the ground, were empty, some contained only a few pot-sherds (St. John's Landing), and the irregular construction of many defied any practical theory of explanation. Sometimes relics were scattered broadcast about the mound, out of all relation to its shape, and not associated with any burial. There were cutting-tools of soft rock that use would have destroyed, "ceremonial" shapes of stone and pottery, caches of intractable and useless hornstone chips, and inexplicable arrangements of shells, betokening the doings of men who harkened habitually to the echoes of an invisible world, and, like Congo savages, drew half their life's inspiration from demonology and spirit worship. Here again, science is invited to explain the motive traits of humanity's childhood, and account for facts before it, not alone by the promptings of five senses, but by motives wild as the veering wind,

—motives to understand which is to half reveal the scheme of primitive existence, whose features, faintly suggested by archeology, elude the imagination. He best knows them who, searching deep, dares, like Mr. Cushing, the dreadful initiation of the Indian Priest.

When the mound-makers buried pots with the dead, they often knocked holes in them, not to render them worthless for grave robbers, since valuables often lay close by, but inferably for a religious reason. Sometimes they made the holes before the pottery was baked.

Like the Nanticokes, of Maryland, it appeared that they had dried the flesh of corpses off the bones, stored the latter in charnel houses, and, at given times, buried the store, for, though the interred skeletons found lay sometimes in anatomical order, as if they had been buried with the flesh on the bones, or before the ligaments had rotted, at other times (Duval's) the bones lay scattered in disorder or in bundles (Gunn's Grove), when, occasionally, the remains of one man (Orangedale) got mixed with those of another.

But, in all this, there was nothing extra Indian. Other mound-building tribes had been known to do all or most of these things, and we come to the second question—

(b) DIFFERENCE IN AGE OF THE SITES.

Following the rivers' course, there were two kinds of sites examined—sand mounds built deliberately by piling up loads of sand and earth on one spot, for burial or other purpose, and shell heaps (which, by the way, occur on the river only from its source half way down) made by people eating fresh water mollusks on one spot and throwing the shells under foot. At Tick Island, Bluffton, Thursby's, Thornhill Lake, Mulberry Mound, Gunn's Grove, Fort Taylor, and Raulerson's, the sand mounds were later than the shell heaps, for they were built directly upon the shell heaps. On the other hand, at Orange, the shell heap is later than the sand mound, for it rests upon the sand mound.

If we go by the comparative test of contents, some of the sand mounds and shell heaps must have been contemporaneous, as where, at Mulberry Mound, there were the same kind of tobacco pipes in the sand mound as in the shell heap. A few shell heaps contained plenty of pottery, though, as a general rule, they contained none, and we are left to infer that the art of pottery was unknown at their date, or, more reasonably, as I venture to suggest, (having examined several small sherdless shell heaps at York Harbour, Maine,) that some heaps may have been made entirely of *roasted* clams, where the cooking process (unlike boiling) required no pot. On the other hand, some sand

mounds contained no pottery, and none ever contained a certain kind of earthenware that seemed to have been tempered with small fibrous roots. This, when found at all, was found in the shell heaps. Professor W. H. Holmes, in an appended paper (The Earthenware of Florida), argues that this fibre tempered pottery may, nevertheless, be no older than the other sand mound wares, since often in form (identical with those of the best days of the art) and in design (the scroll pattern), it appears to be up to the finer models of the sand tumuli. Less still does he find characteristics in any of the other earthen specimens, whether from sand mounds or shell heaps and which he describes as paddle-stamped Cherokee fashion, extemporized by amateurs, often coiled, and never made in baskets or nets; chalky often, or gray coated and black within, to warrant the setting aside of any pattern of them all as older than the rest, or the use of any make as a test of age for the mounds or heaps.

Notwithstanding this and the fact that rarely the shell heaps (Persimmon Mound) were used like the sand mounds for burial, Mr. Moore thinks for the reasons aflove given, that the shell heaps, as a general rule, belong to an older time than the mounds.

(c) MOUNDS BEFORE AND AFTER WHITE CONTACT.

Though there can be no doubt that some of the tumuli were built before the coming of white men, there seems to be no reason for supposing that these mounds of Florida are any older than any other class of mounds or shell heaps in the United States. The mammoth's molar (Gunn's Grove) appears to have been picked up by a curiosity-loving Indian and used as a trinket. But there is nothing in the animal bones mentioned to suggest that the mound-maker was the contemporary of an extinct fauna, though the clay model of a tapir-like snouted animal (Volusia Mound) may mean that these people, like the Indians of Tennesee, saw the tapir.

Some of the mounds were built after the coming of the whites. There is no question about that, for glass beads and iron were found in the bases of them with disassociated bones, complete skeletons and bunched burials (Ranlerson's). There was a silver ornament and an iron axe at the bottom of Dunn's Creek Mound, and two skeletons were buried with flint-lock muskets and glass beads at Bayard's Point.

Some mounds, really pre-Columbian, and, in their original bedding, showing no white man's trace, had been notched on their sides and top with comparatively recent Indian graves containing European trinkets, and glass beads were found about the surface of some others (Volu-

sia, Thursby's, Gunn's Grove and Cook's Ferry). But many others again (Mount Royal, etc., etc.), which showed, from top to bottom, no trace of the white man, must, inferably, have been built before the coming of Europeans.

(d) MOUND COPPER NOT OF EUROPEAN ORIGIN.

To find an object of European make in a mound, is to date the mound after white contact, that is certain. But when we ask which objects were and which were not of European make or suggestion, and set aside a number of things easily in one category or the other, we soon come to the doubtful case of copper—copper which was mined by the Indians on Lake Superior to be pounded cold into trinkets; copper which the Spaniards found Indians casting in moulds in Mexico, and which, on the other hand, was traded to Indians by Europeans in the sixteenth century, to be again worked into trinkets. The copper in these mounds (Tick Island and Mount Royal), as in Ohio, (Hopewell's) appears in such smooth and extremely thin discs and plates, that, spite of its position at the mound's base, with no associated trace of Europe; spite of the aboriginal pattern, certain archaeologists would not believe it of American manufacture. Until Mr. F. H. Cushing succeeded in reproducing the specimens in cold hammered native copper, with Indian tools, the opinion held its own that the mound-makers had cut the shapes out of machine-rolled sheets brought from Europe. To settle this question, Mr. Moore has employed, at great pains and with great credit to his energy, the test of analysis.

That a component alloy should occur in European copper of the time in question, which never occurs in these mound specimens, and which likewise never occurs in the pure native material found in America, was a lucky chance. But such was proved, in a reasonable number of analyses, to be the case, and it settled the question. The tell-tale alloy is lead. The mound copper examined always had fewer impurities (sometimes only silver and iron) than the European, antimony and arsenic were from 19 to 45 times less abundant in mound copper than in European, but lead was *always* present in the European and never in the mound specimens analyzed.

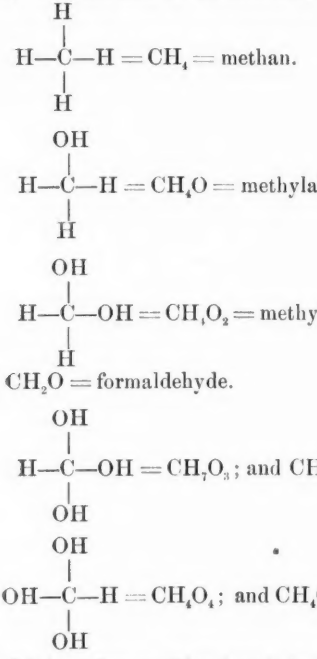
It was only making assurance doubly sure to urge, after this, that the mound *designs* were aboriginal; that the objects of the same kind differed in size and shape, which, inferably, machine-made specimens would not do; that the Mount Royal breast-plate, though symmetrical, was not mechanically so; that the large plates were not originally made from single sheets, such as European mechanics would have fur-

nished, but from ragged-edged fragments rivetted together; and, finally, that the copper specimens were never found associated with objects of white man's make. But the main point had been already reasonably proved. The absence of lead had settled the question, and wherever the mound-building Floridans got their raw material, whether from the ancient diggings at Lake Superior, from Mexico, or from Cuba, where lead is equally absent in the native deposits, it never came from Europe.

H. C. MERCER.

MICROSCOPY.[1]

Formol as a Preserving Fluid.[2]—If the four atoms of hydrogen in the simple organic combination, swamp gas or methan, be replaced by a hydroxyl group there may be formed, one after the other, partly by the separation of water, (1) methylalcohol, (2) methylenglycol, (3) formic acid, and (4) carbon dioxide. The process may be illustrated in the following manner:



Of these five combinations it is formaldehyde that concerns us. It was discovered in 1863 by A. W. Hoffmann while passing wood spirit (methylalcohol) and air over a red hot platinum spiral. If the vapor

[1] Edited by C. O. Whitman, University of Chicago.

[2] The first half of this paper is a free translation of a paper by Prof. T. Blum in the Bericht. über d. senckenbergische naturf. Gesell. in Frankf. a. M., 1894, p. 195.—F. C. K.

is brought into water to its point of saturation, a 40 per cent solution of formaldehyde is obtained, which has long been known under the name of formol. The use of the termination "ol," here has been objected to as belonging especially to alcohols, but since we have to do not with the vapory formaldehyde of the discoverer, but with the hydrate, methylenglycol, an alcohol, this objection is not well founded. The first experiments as to the value of an aqueous solution of formaldehyde for the purposes of disinfection, hardening and preservation, were made with the solution under the name of formol; therefore, the general custom of priority giving the honor, I shall use the term formol.

Formol is a clear, slightly opalescent fluid with a sharp odor. By dilution of the fluid the odor is lessened and the liquid remains as clear as water. It is best kept in glass vessels. In metal ones it often becomes of dark brown color and must then be allowed to stand quietly in a glass vessel before diluting for use. From the quiet liquid there settles a light cloudy precipitate leaving the liquid clear. A change of formaldehyde to an insoluable paraformaldehyde, that has here and there been noted, I have never met with.

After my son, Dr. F. Blum, made the discovery that formaldehyde posessed besides its known antiseptic action, the noteworthy property of hardening animal tissues without their shrinking and without altering their microscopic structure or staining properties, formol appeared to me to be the preservative fluid for which I had long sought. Without loss of time, I began my experiments upon animal and plant objects. These gave within the short space of a few months such encouraging results that I did not hesitate to publish them in a preliminary paper.[3] Since then the experiments have been continued at the Museum der Senckenbergischen naturforchenden Gesellschaft, and in different places others have likewise tested the preservative properties of the fluid.

Among my experiments those that follow are the most important. To begin with, several human embryos were placed according to age in formol diluted with 10 and with 20 parts of water and were finely preserved. Even a fœtus of 8 months in which the placenta and egg membranes were left intact, had taken up so much formol that it was hardened in spite of the resistance of the chorion to the diffusion of the liquid. The amniotic fluid was darkened, but the surrounding liquid remained clear. Somewhat finer results were obtained with smaller embryos. In one about 14 cm. long with uninjured amnion, this being thinner,

[3] Zoologischer Anzeiger, 1893, No. 434.

the amniotic fluid did not become turbid. Through it each structural particular of the embryo and navel cord is easily recognized. The temporal artery shows through the transparent skin as a dark brown streak, while beneath it is seen the brain through its capsule. In an embryo a little larger (30 cm.), the fine hair and hair follicles are finely preserved. This last embryo was in a 1:20 solution.

Experiments with a corpse have not been made, yet the possibility of one keeping, may be with safety assumed. In order not to be obliged to inject the fluid, it might be necessary to employ the stronger, at least 1:10 solution.

Of the Mammalia, mouse, hamster and porpoise have been left in a 1:10 solution for over three-fourths of a year. The fluid has not been changed and yet remains perfectly clear, while the animals are well hardened, unaltered in form and color, and with the hair firmly in place. The mammalian eye as well as that of other vertebrates keeps better in formol than in alcohol. Still after a time a turbidness appears —more in the lens than in the cornea.

Reptilia and Amphibia preserve well. Frogs, in consequence of the entrance of the fluid into the subdermal space, appear swollen, but in other respects are unchanged.

For fishes, formol especially recommends itself. The mucous and slime remain clearly transparent, never forming the white, stringy mass arising in alcoholic preparations. Most fishes retain their colors more or less completely. Gold fish, to be sure, loose their color in very weak solutions, and the red spots of the trout become white with time. A solution diluted 1:10, 1:20, or 1:30, according to the size of the animals may be used. In a short time the animals are very nicely hardened.

From a number of invertebrates I may mention that snails, especially slugs, show their form and colors through the transparent slime. Insects, spiders and Crustacea preserve at least as well in formol as in alcohol.

Living Hirudinea are contracted more in formol than in alcohol; at least the contracted specimens are numerous and the extended ones few. The straw-yellow colors disappear sooner, while, on the other hand, orange-yellow, green, brown and black remain unchanged.

Two jelly fish (*Aurelia aurita*) killed in a 1:20 solution and kept one in a 1:30, the other in a 1:50 solution, were hardened without an alteration of form, color, or transparency. That kept in the 1:30 solution is the better, but neither have been long in the fluid.

Single organs or pieces of muscle are quickly hardened in formol. It is notable, as pointed out by my son,[4] that the coloring matter of the blood is distinctly retained. The blood courses, it is true, fade and finally to all appearances disappear, but if the preparation be placed in alcohol of not too great a strength (60–90 per cent.)—the stronger the quicker the reaction—the characteristic blood color returns and there is obtained an excellent representation of the branching of the vessels. The change from formol to alcohol and *vice versa* may be repeated always the same results.

Brain hardened in formol gives very fine results.[5] Pieces and even the entire brain are hardened very quickly and show the white and gray matter sharply differentiated from one another. Sections are said to be much better than those of chromic acid preparations.

As has been mentioned, neither the microscopic structure nor the staining properties of tissues are destroyed by formol. Almost all the organs and staining methods have been tried. In the preparations, cell body and cell structure, as well as the nucleus caught both in the resting state and in process of division are fixed, while the blood corpuscles are sharply marked off from their surroundings.

Hens' eggs have been tried and have in many ways led to very interesting results. An unbroken fresh egg in a 1:15 solution showed, after 8 days, the white forming about the yolk a mantle of an outer fluid and an inner slimy consistance. The yolk was hard, remaining fluid only in the middle. The hardening process here then is the reverse of that of cooking. On the day following, the yolk had become much harder, while the white was changed only after a long time and never neared the hardness of the yolk. Upon opening an egg after 38 days a faint odor of formol was perceived. The yolk was hard, sectionable, and showed an outer zone of 1½ mm. breadth and an inner beautiful yellow mass. The yolk was surrounded by a grayish, scarcely sectionable, gelatinous mantle in which the chalazea and germinal spot were plainly visible. About the mantle was a very slightly opalescent albuminous fluid.

A fresh egg with a small hole in it showed under like conditions the same phenomena, but within a shorter time, or about 17 days. After 68 days such an egg was noticeably harder. The firm white clung to

[4] Anatomischer Anzeiger, Vol. ix, No. 7.

[5] See Born, "Demonstration einer Anzahl in Formaldehyde (Formol) gehärteter menschlicher Gehirne." Mediz. Sektion d. schlesisch. Gesell. f. vaterl. Kultur., 1894.

the shell so that it shelled like a cooked egg. The white had the appearance of gelatin, was firm, and whitish-gray. The yolk was very hard and breakable.

Similar results to those with the unbroken eggs were obtained with uninjured eggs in formol vapor (a very few drops).

A cooked egg kept in formol vapor after 30 days appeared as fresh as though newly cooked, smelled of formol on the inside and had a sharp taste.

A fresh, unbroken egg that had been for 75 days in a 1:5 solution of formol was placed for 15 minutes in boiling water. Both yolk and white had the same appearance as in an uncooked egg that had been for a similar length of time in formol. In spite of the long cooking the white had not taken on that beautiful porcelain white appearance common to cooked eggs, and had not changed its firm gellatinous condition. Hence through the action of formol the white of an egg looses the property of coagulating by heat. If, as now assumed, egg-white bodies are those substances that are changed in chemical constitution by the action of formol, then the difference in the action upon the white and the yolk of the hen's egg offers a most worthy test for the study of different albuminous substances.

Experiments with plants were made in considerable number. In general the preservative action of formol upon the colors of flowers is less than the first experiments had led me to hope. Nevertheless, this means of preservation is a step in advance. Many flowers placed in formol during the summer were usable as demonstration preparations during the following winter. A passion flower in a 1:20 solution after nearly ten months, is still a beautiful preparation. Further, many composites, viz., such as had a yellow color, like *Helianthus argyrophyllum*, *Calendula officinalis*, etc., have been well preserved. Also a rhododendron flower (in 1:20), a rose (in 1:50), *Akebia quinata* (1:20), *Cornus mas* (1:20) and so on, have been changed in form and color but little. Fragant flowers and fruits turn the formol to an agreeably odiferous fluid. Chloropyll is not drawn out by the fluid, but the green color of tender leaves become pale with time. A *Dieffenbachia* with a bulb grown upon the spathe is almost faded, but forms never the less a fine preparation. Firm leaves like those of *Rhododendron* are altered but little. Fruits are well preserved. Blue grapes, currants, medlars, several species of *Cratægus*, *Cephalotaxus*, banana, different species of *Solanum*, *Magnolia tripetala*, strawberries, and *Mangifera indica*, that have been in formol ever since the fall of 1893, are nicely preserved. In a very few fruits the action of the preservative is injurious.

The use of a very dilute solution of formol works badly for the reason that from such a fluid the water is absorbed very decidedly. At least fruits became swollen more often than plants in the dilute solutions. Cherries, for instance, keep well in a 1:30 solution, but in one of 1:60 or 1:80 they burst open. The entrance of the fluid into the colored envelopes of flowers is also very noticeable. How dilute the solution may be for the different plants is difficult to say. It must be determined by experiment.

Of Cryptogamous plants I have till now experimented only with truffles (1:10) and young *Phallus impudicus* (1:30). This last was cut in two and forms an excellent preparation.

Cohn declares that formaldehyde forms an excellent means of preserving *Leuconostoc* and chromogenous bacteria since the jelly and color are not changed.[6]

The value of the fluid for preserving bacteria has been noticed by Hauser.[7] He shows that gelatin in which micro-organisms are grown is changed by formaldehyde vapor so that it will not become fluid, and that gelatin already peptonized becomes hard again in the vapor. Neither the gelatin nor the micro-organisms suffer a noticeable change, and the preparations can be kept for demonstration or museum purposes.

In microscopic sections of plants that have been in the preservative (1:20) for several months the cell wall, protoplasm and chlorophyll bodies appear as in fresh specimens.

I have not yet undertaken to determine the freezing point of the formol solution, but will remark that during the past cold winter in an unheated store room the diluted solution was not frozen, and that even in the open air at a temperature of—18° C the concentrated solution remained fluid.

In conclusion the properties of formol as a preservative medium may be summed up as follows:

Animal objects are hardened with shrinking, and without losing their microscopic structure or staining properties.

The natural form and color is preserved.

The eye remains much clearer than in alcohol.

The mucous of slime producing animals is not coagulated and remains transparent.

The coloring matter of blood in tissues apparently disappears, but may be quickly restored by a high per cent alcohol.

[6] Bot. Centralbl., Vol. lvii, No. 1, 1894.

[7] Münchener med. Wochenschrift, 1893, Nos. 30 & 35.

Plant structures are more or less well preserved; most fruits keep well.

Chlorophyll is not extracted, but after a long action of the fluid delicate leaves may be changed. The duration of the retention of other coloring matters is different with individual plants.

Microscopic sections of plants that have been a long time in formol give fine preparations.

Dilute formol is not combustible and is much cheaper than alcohol.

To the above experiments described by Blum may be added those of Dr. Th. Pintner, Dr. C. Krückmann, and a few notes of my own.

Dr. Pintner used a 1 per cent. solution of formaldehyde in sea water for Discomedusæ, *Æquorea* and *Aurelia* without their form being affected.[8] The same solution was used with sponges such as *Suberites dominicula* and *massa*, *Clathria coralloides*, *Aplysina aërophobia*, etc., with equally good results. But animals that contract much in killing must first be treated with Lo Bianco's Naples methods, and then transferred to the solution of formaldehyde. He found that all animals do not retain their color, as for instance, the red coloring matter of actinia and of *Comatula* is extracted.

Dr. Krückmann working with bacteria used stronger solutions and obtained the best results by combining corrosive sublimate with formalin.[9] To begin with, a formalin solution of moderate strength was used and this gradually increased until the specimens were in pure formalin. Bacterial cultures were fixed by placing them in an exciccator containing formalin instead of sulphuric acid, and in order to tan the surface of the medium, it was covered with a 1:10 solution of formalin containing 1 per cent of sublimate. This was later changed to a stronger solution of formalin and the tube hermetically sealed. By following this process he found that colors were much better preserved and the more or less inevitable crumpling very much diminished. The solution worked well with all media except potato.

The few experiments that have been performed by myself seem to indicate that too weak solutions of formalin have hitherto been used except in the bacterial experiments of Krückmann. The material used was what came nearest to hand, and consisted of a tree-frog, salamanders, earth worms, sow-bugs, myriapods, plant-lice, slugs, cat liver and blood, blood of salamander, nostoc and a pond scum. The solutions used varied from ¼ per cent. to pure formalin. Two species of

[8] Ver. zool.-bot. Ges. Wien, xliv, (1894), p. 8.

[9] Centralbl. f. Bakteriol. u. Parasitenk., xv, (1894), pp. 851–7.

Plethodon placed in a 4 per cent. solution of formaldehyde (=10 per cent. of the commercial formalin) were soon killed, and on the day following the immersion were thoroughly hardened and after a week or so have not shrunken noticeably further than that the costal furrows are a little more strongly marked than in life. The reddish coloring of one of them is fully as fresh as when the animal was caught. A tree-frog placed in the same solution at the same time became somewhat swollen, but by cutting the skin in the abdominal region, the swelling was then shown to be due to an entrance of the fluid into the subdermal space as pointed out by Blum. The swollen tongue, which protruded from the mouth a little, would indicate, however, that there had been a swelling of some of the tissues. The same swelling of the head was noticed in the salamanders, but with them it is not so marked.

A single adult *Amblystoma punctatum*, that had been first anesthetized with chloroform, was placed in a solution equivalent to about 1 per cent. of formaldehyde, and was found to harden rapidly. There was, however, a very noticeable swelling of the whole body within twenty-four hours, while, at the same time, the costal furrows, as in the *Plethodon* specimens, became more marked. After about a week's immersion in the 1 per cent. solution, it was found that the bright orange-yellow spots of the live animal had very noticeably faded to light yellow. The specimen was then changed to a 4 per cent. solution and after an equal length of time the fading appeared to have gone no further, while the swelling was somewhat reduced. As it is the specimen is much better preserved than it would have been in alcohol.

Earthworms and the Arthropods were tried in all solutions. The former swell but slightly in the weaker solutions and contract very much less in the stronger ones than they would in alcohol, chromic acid or the other hardening agents. They harden in a ¼ per cent. solution as well as in the stronger ones or in pure formalin, the difference being one of time. In the Arthropods—sow-bugs and myriapods—the fluid in some of the experiments entered the body to such an extent as to stretch the animals out, leaving broad gaps between the harder parts of the segments. This stretching or swelling was first seen in the specimens in the 1 and 2 per cent. solutions, but sometime later those in all the solutions below 1 per cent. were fully as badly swollen, if not more so. Besides this the brownish colors of the animals became more faint, while the fluid became very much colored. This extraction of color is most noticeable with the ¼ per cent. solution.

Slugs placed in ¼, ½, ¾, 1, 2, 4. 8, 10 and 20 per cent. solutions seem equally well preserved. In the 1 and 2 per cent. solutions the head is

a little more distended than in the others. When first placed in the solution they gave off considerable slime, but this became perfectly transparent so, as noted by Blum, the form and colors of the animals were not obscured.

With salamander blood some startling effects were obtained. A few drops of blood were placed on a slide in a 1 per cent. solution of formaldehyde and watched under the microscope. The corpuscles and especially the nuclei were seen to swell rapidly. The nuclei became as large almost as the original corpuscles and were seen to pop out of the corpuscle like a grape from its skin. The envelopes then became very pale and finally disappeared from view, the nuclei, however, remained very distinct. Staining with Erlich-Biondi mixture showed that the body of the corpuscles had simply been rendered very transparent by the solution, while immersion in alcohol coagulated the fibrin into an opaque, straw-yellow mass, and brought the corpuscles faintly back into view. This explains the phenomenon of the return of the color of blood vessels noted by Blum as due to the coagulation of the fibrin which may also be stained somewhat by the color drawn from the corpuscles. The same experiment was performed with a 4 per cent. formaldehyde solution in place of the weaker one and the swelling effect found to be very much lessened, none of the nuclei becoming as large as the corpuscle nor escaping, otherwise the results were the same.

After this an earthworm was anesthetized with chloroform, placed in a 1 per cent solution of formaldehyde for several hours and afterwards removed to a 2 per cent. solution. There it remained for an equal length of time, when it seemed perfectly hardened and was removed to Czoker's alum cochineal. On the following day pieces were rapidly dehydrated in 70 per cent. and 95 per cent. alcohol and imbedded in paraffin. Sections made from them showed all micro-anatomical details perfectly preserved. Nothing had stained but the nuclei which had all become very much swollen, giving the whole section a bright red-purple appearance. So decidedly had they swollen that in both series of the muscular system, and in the septa where they are not ordinarily visible, nuclei were shown very distinctly and in large numbers. Careful observation showed the nucleolus a little more deeply colored than the rest, while the chromatic filaments seemed swollen and less distinct.

Sections were also made of an earthworm hardened in pure formalin and no swelling whatever was to be noticed, while all cytological detail was remarkably well preserved.

To counteract the swelling effect of the weak solutions alcohol was employed. A 5 per cent. solution of formaldehyde in 50 per cent. alcohol hardened pieces of earthworm and cat liver very rapidly, so that on the day following their immersion, sections could be obtained by the paraffin method. Here the nuclei were found not to have swollen noticeably, if at all, while nuclear detail was plainly brought out by staining. In the pieces as a whole, there was neither swelling nor shrinkage, while the liver did not become as pale as it would have in alcohol.

For stains alum cochineal, Erlich-Biondi, Orth's picro-carminate of lithium, Erlich's acid hæmatoxylin, picric acid, fuchsin and saffranin were tried and their action found not to be very much if at all interferred with by the formaldehyde. In one instance a piece of an earthworm was placed in equal parts of 2 per cent. formaldehyde and alum cochineal. On the following day it had been little more than superficially reddened, while a piece that had been removed from the same solution (2 per cent.) of formaldehyde and left for the same length of time in undiluted alum cochineal had stained perfectly.

In *Nostoc* the dark yellowish-green has been extracted in 4 per cent formaldehyde leaving the filaments as seen with the naked eye of a whitish or very light green, while a dark green pond scum after immersion in the fluid for nearly two weeks has changed slightly to brownish-green. Still it is not unlike old specimens of the same and similar material that one often finds in ponds.

In conclusion it may be said that for general purposes, solutions of at least more than 2 per cent. must be used in order to avoid the swelling and decolorization of specimens, that from 4–8 per cent. will give the best results. For histological purposes formalin combined with alcohol will give better results than either used alone; while the weak (1–2 per cent.) solutions by swelling nuclei may serve the very important special purpose of demonstrating the presence of cells not otherwise readily distinguished.

F. C. Kenyon.

SCIENTIFIC NEWS.

Bibliographical Reform.—The pressing need of an improvement in the methods of indexing scientific literature is admitted on all sides. Especially a young and growing science like zoology feels this want.

Present bibliographical aids are inadequate in three principal re-respects: First, they are incomplete; second, they are tardy in furnishing notices of papers; and third, they do not enable one to find quickly all references to any subject of which one desires the literature.

Although at various times attention has been called to the exisiting imperfections in our bibliographical service, it is only lately that active steps have been taken to improve that service radically.

Over a year ago Dr. H. H. Field began to agitate the matter of reform in the bibliography of zoological literature by a letter, printed in Nature (Vol. xlvii, p. 607, Apr. 27, 1893). Last spring the Royal Society of London, whose Catalogue of Scientific Periodicals is well known, sent a circular to scientific men and institutions asking for suggestions concerning the compilation through international coöperation, beginning with the year 1900, of a complete catalogue of scientific literature, giving not only titles arranged according to authors's names, but also an index to subject matter. This request has already excited earnest attention and seems certain to elicit a cordial response.

Dr. Field's plan in no wise conflicts with the Royal Society's purpose; it may, indeed, be said to coöperate in it. He believes that the reform on the zoological side ought not and need not wait half a decade. It should begin at once. If the plan proposed by Field should be successful it would show the probability of success of the larger undertaking mentioned in the Royal Society's circular. If that undertaking should be begun in 1900 the zoological part of the work, already organized would be easily absorbed by it.

Field has already drawn up the outlines of a definite plan after consultation with prominent zoological bibliographers in Europe. These he has already published. Besides the printed letter in Nature, referred to above, a statement of his plan can be found in the Biologisches Centralblatt, Bd. xiv, pp. 269–272; Verhandl. Deutschen Zool. Gesell. iv Jahresversammlung, 1894; and Mém. Soc. Zoologique de France, Tome vii, pp. 259–263.

The essential points of his plan are these: First a single international bureau, situated at some great library centre in Europe, which shall receive all zoological papers. It shall make such arrangements as are necessary with governments, publishers and directors of zoological institutions for obtaining all zoological publications, and it shall have agents in every country or province to see that the literature of that region is sent to the bureau.

This bureau will obtain synopses of the contents of all papers and books, through authors, publishers and paid agents. The central bureau will, moreover, superintend the printing and distribution of its publications.

This bureau will also naturally acquire, in time, an invaluable collection of the entire zoological literature from the time of its foundation.

Second, publications in two forms: 1st, a pamphlet of titles and books with short synopses, resembling, but somewhat more extended than the various more or less incomplete bibliographical lists now published in different periodicals. This pamphlet to be issued at brief intervals. 2nd., the same titles including synopsis printed either on one side of a narrow sheet or on separate cards of standard size. The synopses to give a clue to the contents of the papers and to serve as a basis for the arrangement of the cards according to subjects. At suitable intervals a subject index to the literature, based on these synopses to be published.

Field had the intention of submitting his plan to the American Society of Naturalists at their New Haven meeting, last year, in order that they might be the first to appoint a committees to confer with similar foreign committees in the further elaboration and the inauguration of the undertaking. He believed that, owing to the friendly relations existing between this country and all European nations, America could best take the initiative in this work. Owing to an unfortunate delay in the mails, however, Field's paper, presenting the subject, came too late for presentation to the American Society.

Since that time Field has submitted his plan to the zoological Societies of Germany, France, and Russia and these have appointed committees to act together in considering the details of the plan and methods of supporting it. Besides the recognition by societies, numerous individual zoologists of Germany, France, Russia and England—among them v. Bardeleben, Bouvier, Dohrn, Hoyer, Paul Mayer, Minchin, Mitrophanow, and Schimkewitsch—have signified their interest in the plan and many of these their willingness to coöperate.]

Although American zoologists cannot be the first to make a definite move in the direction of bibliographical reform their hearty coöperation at the present critical time will help to make it an accomplished fact.

Besides coöperating with the committees from other countries, American zoologists can contribute to the success of the plan in two ways. They can see that copies of their own and others' publications are forwarded to the central bureau and they can make synopses of their own papers and others dealing with their specialities. Those who are willing to aid in these directions should communicate with DR. H. H. FIELD, 67 RUE DE BUFFON, PARIS, FRANCE.

An Academy of Sciences for Michigan.—At a meeting of about 25 persons, held in Ann Arbor, June 27, 1894, it was unanimously agreed that it was desirable to form a society for the purpose of scientific research in the State of Michigan.

At this meeting, the officers whose names are appended were elected to serve until a permanent organization should be effected, and were instructed to act as an advisory board with the duty of recommending a constitution and by-laws for adoption by the society, and of preparing a program for the next meeting.

At a meeting of the advisory board it was unamiously agreed to recommend that the name of the society be the "Michigan Academy of Sciences," and that it have for its principal object the study of the agriculture, archeology, botany, geography, geology, mineral resources, zoology. etc., etc., of the State of Michigan, and the diffusion of the knowledge thus gained among them. It is not the opinion of the advisory board, however, that the work of the society should be restricted to the subjects named but should be enlarged from time to time as occasion may require.

W. J. Beal, President, Agri. College; J. B. Steere, Vice-President, Ann Arbor; F. C. Newcomb, Secretary, Ann Arbor; W. B. Barrows, Agr. College; I. C. Russel, Ann Arbor.

The Journal of the Biological Association of the United Kingdom (Vol. iii, No. 3, 1894) contains, besides special articles noticed elsewhere, the report of the director, from which we learn that 12 persons occupied tables during the year 1893–4, and that 9 articles were published as results of work done there. The expenses of the year amounted to about $11,000. We regret to see that the regular receipts are not sufficient to meet the outlay. An interesting fact is that over $350 was received from entrances to the aquarium room.

Dr. H. Solereder has been appointed custodian of the botanical collections at Munich.

Dr. Zimmermann has been made professor extraordinarius of botany at Tübingen.

Dr. Filhol is the professor of comparative anatomy at the Museum of Natural History at Paris, succeeding Pouchet.

Dr. A. Oppel has been appointed extraordinarius in embryology and microscopy at Freiburg, i. B.

Dr. E. Stolley has been appointed docent in Geology at Kiel.

Major C. L. Griesbach, for twenty years connected with the survey, has been appointed director of the Geological Survey of India.

A new biological journal has appeared in Germany, the "Archiv für Entwichlungsmechanik" edited by Prof. Wilhelm Roux of Innsbruck and issued by the house of Engelmann in Leipzig. The first number contains the following papers. Roux, Cytotropismus of the blastomeres of *Rana fusca*; Ribbert, compensational hypertrophy and regeneration; Barfurth, experimental regeneration of superfluous limbs in Amphibia; Barfurth, are the limbs of frogs capable of regeneration? Tournier, origin of joint forms. The first number is illustrated by 7 plates and costs 10 marks. Each volume will contain about 650 pages.

An appreciative sketch of the late Dr. H. A. Hagen by Samuel Henshaw appears in vol. xxix of the Proceedings of the American Academy of Arts and Sciences.

Dr. Altmann has been made professor extraordinarius of Botany at Freiburg iB.

Dr. Ed. Holzapfel has been appointed professor of Geology and Paleontology in the technical school at Aix la Chapelle.

Dr. Rudolf Burckhardt, formerly of Berlin, is now extraordinary professor of comparative anatomy at Basel.

Dr. Erich Haase, the well-known student of myriapods, died in Siam, in the last of May.

Prof. J. Jägge, director of the botanical museum at Zürich, died June 21, 1894.

Dr. O. Th. Sandahl, the physiologist, died at Stockholm, June 22.

Dr. Paul Albrecht, of Hamburg, is dead.

Dr. Carl von Heider, formerly of Berlin, has been called as ordinary professor of zoology, and Dr. M. von Lenhossek of Würzburg as professor of anatomy, at Innsbruch.

Dr. R. von Lendenfeld becomes ordinary professor of zoology in Czernowitz.

Dr. Schewiakoff of Heidelberg goes as assistant in the Zoological Institute of St. Petersburg.

A. C. Gill has been appointed assistant professor of mineralogy and petrology at Cornell University, and Gilbert D. Harris assistant professor of Paleontology at the same institution.

Miss L. C. Deane has been appointed instructor in biology at Vassar College.

At Wellesley College the following appointments have been made: Edith J. Claypole and Miss Hubbard, instructors in physiology; Elizabeth F. Fisher, instructor in geology and mineralogy.

Charles S. Prosser, formerly instructor at Cornell University, has been called to the chair of geology in Union College.

Dr. W. S. Nickerson is occupying (ad interim) the chair of biology and histology in the University of Colorado at Boulder.

Recent Deaths.—Prof. Paul Albrecht, vertebrate anatomist, of Hamburg, Sept. 15, 1894. Dr. C. M. von Bauernfeind, Director of the Technical School of Munich, August 2, 1894. Prof. Friedrich Bidder, physiologist, of Dorpat, August 31, 1894, aged 84 years. G. Cotteau, student of Echinoderms, of Auxiere, at Paris, August 10, 1894. Prof. A. Hannover, anatomist, at Copenhagen, July 8, 1894, aged 80. Salomon Herzenstein, Conservator of the Zoological Museum of St. Petersburg, ichthyologist, August 19, 1894, aged 40. A. F. Kuwert, coleopterist, at Wernsdorf in Prussia, August 15, 1894. Prof. Michele Lessona, zoologist, at Turin, July 20, 1894, aged 71. F. E. Mallard, mineralogist and crystallographer, at Paris, July 6, 1894. Prof. Natanael Pringsheim, the well-known botanist, at Berlin, October 6, 1894, aged 70. Baron Gerhard-Maydell-Stenhusen, botanist and Siberian explorer, at Bad Ems, August 18, 1894. W. Topley, geologist, at London, Sept. 30, 1894, aged 53.

DREPANORNIS ALBERTISII
"From D'albertis"